SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MAY, 1927.

GENERAL PHYSICS.

1234. *Dependence of Density on Temperature.* **A. Predwoditelew.** (Zeits. f. Physik, 40. 6. pp. 474–476, 1926.)—It is shown that the observations of Batschinski and Schaposchnikow [see Abstract 260 (1927)] on the writer's work [see Abstract 1970 (1926)] on the dependence of the density of fluids on temperature are unfounded. Formulæ are given for the temperature relations of the density of fluids. J. E.

1235. *Density of Oxygen and its Compressibility below one Atmosphere. Part II.* **G. P. Baxter** and **H. W. Starkweather.** (Nat. Acad. Sci., Proc. 12. pp. 699–703, Dec., 1926.)—The mean value previously given for the density of oxygen under a pressure of 1 atmos. [Abstract 734 (1925)] is subject to the correction $-0\cdot00003$, an incorrect value for the force of gravity having been used in the calculations. The corrected value, 1·42898, is identical with the last three results, and is unquestionably the best. New measurements at atmospheric and also at lower pressures give the values 1·42896, 1·42898, 1·42896 and 1·42896, and show that if pv at 1 atmos. is taken as 1, the value at zero pressure will be 1·00092. The corresponding limiting value of molal volume is 22·4144 litres.

T. H. P.

1236. *Density, Compressibility and Atomic Weight of Nitrogen.* **G. P. Baxter** and **H. W. Starkweather.** (Nat. Acad. Sci., Proc. 12. pp. 703–707, Dec., 1926.)—The density of nitrogen is found to be 1·25036 at 760 mm. pressure, 0·83348 at 506·67 mm., and 0·41667 at 253·33 mm., so that the value of pv is 1 at 1 atmos., 1·00011 at 2/3 atmos., 1·00028 at 1/3 atmos., and 1·00039 at infinite dilution. The normal density and the deviation from Boyle's law, together with the corresponding magnitudes for oxygen, give the value 14·006 for the atomic weight of nitrogen. T. H. P.

1237. *Molecular Structure in Solution. Part I. The Densities and Viscosities of Aqueous Solutions of Cobalt Chloride and Hydrochloric Acid.* **O. R. Howell.** (Chem. Soc., J. pp. 158–170, Jan., 1927.)—Determinations are made of the densities and viscosities of a series of aqueous solutions containing a constant amount of cobalt chloride and varying amounts of hydrochloric acid, and the values are compared with those of an exactly similar series containing hydrochloric acid alone. From the differences in values for corresponding solutions the effect of the acid on the cobalt in solution is followed. The curve showing the differences in density exhibits a point of inflexion and that showing the differences in viscosity a maximum, both well-defined and at the same concentration of acid. The general form of the curves and these two important characteristics are explained by attributing the action of the acid to the forcing of the cobalt atom out of its association with six molecules of water into an association with four atoms of chlorine. The change of colour from red to blue and the point at which it occurs are accounted for. [See also Abstract 24 (1925).] J. N. P.

1238. *Mass-Weight Ratio.* **H. H. Potter.** (Roy Soc., Proc. 113. pp. 731–732, Jan. 1, 1927.)—A continuation of previous work [see Abstract 731 (1924)]. It then appeared that substances rich in hydrogen appeared to have an abnormally high acceleration, compared with helium-structured substances. The experiments have been repeated with an Eötvös torsion-balance. Brass was taken as standard (practically all "helium") and ammonium fluoride and paraffin-wax compared with it. Precautions were taken to earth the specimens. The probable error of the experiments was about one in 15×10^6. No difference in the mass-weight ratios for the three substances could be found. No anomalous results were obtained with bismuth. A. C. M.

1239. *Auxiliary Apparatus for Vacuum and Gas Technique.* **E. Brüche.** (Zeits. techn. Physik, 8. 1. pp. 12–15, 1927.)—A reducing valve which permits the slow passage of gas at a predetermined rate into an exhausted space, the gas coming into contact only with glass and mercury is described. J. S. G. T.

1240. *A Continuous Integraph.* **V. Bush, F. D. Gage and H. R. Stewart.** (Frank. Inst., J. 203. pp. 63–84, Jan., 1927.)—A description of a mechanical integraph which has been developed for plotting continuously the integral of a product of two functions. It uses the principle of the electrical integrating watthour meter combined with a moving table. Errors of the machine have been reduced to an average of 1 % for common uses. By cross-connecting the device in a simple mechanical way, it is possible to solve certain types of integral equations. A link motion has been added which plots the product of two given functions. Various uses have been made of the instrument for solving problems in connection with electrical circuits, continuous beams, etc., and certain problems involving integral equations. E. G.

1241. *A Hot-Wire Instrument for Measuring Speed and Direction of Airflow.* **L. F. G. Simmons** and **A. Bailey.** (Phil. Mag. 3. pp. 81–96, Jan., 1927.)—A form of hot-wire speed and direction meter suitable for use over a large range of wind speed, and possessing a high order of directional sensitivity, is described at some length. Its development is traced from the initial stages of a wire set along the wind to its ultimate form consisting of a grouping of three wires. Measurements of airflow behind a finite aerofoil made with the three-wire instrument are included for purposes of comparison with corresponding measurements obtained with the standard form of tube instrument. **Authors.**

1242. *A New Planimeter Theory. The Planimeter as Integration Instrument.* **J. Groeneveld.** (Zeits. Instrumentenk. **47.** pp. 1–16, Jan., and pp. 113–134, March, 1927.)—The first paper considers the mathematics of planimeters and commences by proving the proposition that for ordinary instruments the reading A is equal to

$$[(\mathrm{R} + y) \,.\, x - \mathrm{R}^2 x/(\mathrm{R} + y)] \,.\, h/2,$$

when the point moves along a circle of radius $\mathrm{R} + y$ for an arc-length x, where R and h are apparatus constants, and where $\mathrm{A} = 0$ when $y = 0$. Then for every setting of the instrument there will be a null circle of radius R. The examples worked out include the ordinary linear, Sang, and disc-polar planimeters. Part II of the paper extends the theory to the linear momentum planimeter used for the determination of integrals of the form $\mathrm{M}_r = 1/\nu \int_a^b [f(x)]^\nu dx$. The examples dealt with are the planimeters of Hele-Shaw and Amsler-Laffon. Part III discusses polar planimeters which deal with integrals of the form

$$\mathrm{M}_r = 1/2\nu \int_{\phi_1}^{\phi_2} [\rho(\phi)]^{2\nu} d\phi.$$

The second paper deals very fully with planimeters from the standpoint of indefinite integration, and especially investigates the integration of the ballistic integrals. **H. H. Ho.**

1243. *Capillarity and Displacement.* **K. Schultze.** (Kolloid Zeits. **41.** pp. 6–11, Jan., 1927.)—When a rather wide capillary glass tube of elliptical cross-section is dipped into water so as to be completely filled and is then withdrawn and held vertically, some water drops off and a meniscus forms at the top. As the liquid evaporates the upper meniscus sinks, the drop vanishes, and a lower meniscus of opposite curvature forms; the liquid column between the two menisci then rises. The phenomenon, which may last three days, can be accelerated by applying blotting-paper to the lower end of the tube. When a glass capillary is first filled with petroleum ether and then dipped vertically into ammoniacal copper sulphate, the blue liquid is seen to creep up along the glass walls, between the ether film and the glass, as a thin film or film threads which finally pierce the meniscus film of the ether and rise above it, so that the ether column in the tube and its film are surrounded by the meniscus and the longer film of the salt solution. When, however, the capillary is short and quite full of petroleum ether, the salt solution is unable to penetrate up the tube and displace the ether. In this case of non-miscible liquids the ether is displaced by a liquid of higher surface tension; similar observations are made when this relationship is reversed. It is not necessary that the tube should dip all the time in the liquid in the trough, it suffices even to hold the tube over a dish containing ethyl ether; the vapours then penetrate up the tube. This observation appears to support the view of Ostwald that the meniscus of a liquid is part of a froth bubble. A certain irregularity in the cross-section of the tube, which should be open at the top, is necessary for the phenomenon. When a liquid is introduced from above into a tube containing a liquid of higher surface tension, the column between the two menisci sinks, instead of rising. The experiment can also be made in tubes made of agar jelly, about 1 mm. square, prepared by a casting process; since the agar itself contains up to 98 % of water, there are always several liquids present in experiments with such gels. H. B.

1244. *Graphic Determination of Viscosity—Shear Gradient Curves.* **E. Hatschek.** (Kolloid Zeits. 41. pp. 11–14, Jan., 1927.)—The author and R. S. Jane had shown (*ibid.*, 39. p. 300) that, by observing the diminution with time of the torsion in a Schwedoff apparatus, the following expression could be found for the viscosity of a liquid of very low shear gradient: $N\delta = -\kappa\eta d\delta/dt$, where N is the resistance moment of the wire for torsion expressed in circular measure, δ the angle of torsion at time t, and k an apparatus constant. From the differential equation a graphic method can be deduced for constructing the π-shear-gradient (or angular velocity) curve. When the t are plotted as abscissæ and δ as ordinates, the $\delta dt/d\delta$ is the subtangent of the curve, and the $d\delta/dt$, the trigonometrical tangent of the angle between the tangent and the t axis, is proportional to the angular velocity ω (the shear gradient). This curve shows a steep, probably asymptotic, rise of the viscosity with decreasing ω within the range between $2 \cdot 10^{-4}$ and $1.4 \cdot 10^{-3}$ degrees of arc per sec. Experiments with gelatine sols indicate that for $\omega = 0$, δ also becomes $= 0$, *i.e.*, the δ axis is not cut at a finite distance from the origin although the sol in question possesses a certain shear elasticity. Reference is made to similar experiments by Freundlich (*ibid.*, 38, p. 48) in a Couette apparatus. H. B.

1245. *Diffusion of Hydrogen through Metals.* **G. Borelius** and **S. Lindblom.** (Ann. d. Physik, 82. 2. pp. 201–226, Jan. 12, 1927.)—Quantitative experiments are described on the diffusion of hydrogen through the walls of metallic tubes at various pressures below atmospheric and at temperatures up to 700° C. Ordinary hydrogen and also that generated electrolytically at different current densities have been employed. The temperature dependence at constant pressure was similar to that found by Richardson, Nicol, and Parnell for platinum [see Abstract 2460 (1904)] and characterised by a factor $e^{-b/T}$. At constant temperatures the diffusion was proportional to $\sqrt{p} - \sqrt{p_t}$ for $p > p_t$, where p_t is a threshold value of the pressure. Bodenstein's proportionality [see Abstract 1004 (1923)] with $\sqrt{I}$ for electrolytic hydrogen, where I is the current density, is now shown to vary as $\sqrt{I} - \sqrt{I_t}$ between 0·005–0·05 amp./c.cm., I_t being a threshold value of the current density. A complete analogy appears to exist between the diffusion laws for ordinary and electrolytic hydrogen. A theoretical discussion concludes the paper. H. H. Ho.

1246. *Discontinuous Flow Past an Aerofoil.* **S. Yokota.** (Phil. Mag. 3. pp. 216–219, Jan., 1927.)—Morton [see Abstract 1363 (1921)] has given a solution for the discontinuous flow of liquid past a wedge, and the present author now shows this method to have a wider range of application than at first appears, since the general solution of the flow of liquid bounded by two plane laminæ placed arbitrarily may be obtained by a similar process. The paper accordingly describes how the discontinuous flow past an aerofoil may be partly solved by an application of the modified Morton's method to the case of an aerofoil of very long aspect ratio in a current of perfect liquid. The existence of velocity potential is assumed, and the result corrected for the effect of viscosity as is done in shipbuilding calculations, or with the aid of the "Grenzschicht" theory. **H. H. Ho.**

1247. *Flow Round a Model Screw Working in Water.* **C. N. H. Lock** and **H. C. H. Townend.** (Phil. Mag. 3. pp. 224–228, Jan., 1927.)—When an airscrew rotates in a fluid which has a movement of translation, a thrust is produced which is considered positive when the force produced acts in the same sense as the movement of the fluid. Three cases arise, *viz.*, (*a*) the normal working state, in which the thrust and movement are in the same direction; (*b*) the "windmill brake state," in which the thrust is negative, but the resultant of the thrust and the movement is still positive; and (*c*) the "vortex ring state," in which the negative thrust is so great that the motion of the fluid through the screw is opposite to the general movement of the bulk of the fluid. The paper contains photographs of states (*b*) and (*c*). These show very clearly the positions of the vortex rings formed under different sets of conditions. **J. W. T. W.**

1248. *The Turbulence Problem for the Current between Parallel Displaced Walls.* **H. Lorenz.** (Phys. Zeits. 28. pp. 12–16, Jan. 1, 1927.)—From the equations of motion of a liquid flowing between walls, conditions are first worked out for linear velocity distribution and then for turbulence. Comparison is made with Couette's experimental data with satisfactory agreement as also with Heisenberg's results obtained from different considerations. The resistance law of the turbulence is then derived. The paper is entirely mathematical. **H. H. Ho.**

1249. *Theorems Concerning Mean Values of Analytic Functions.* **G. H. Hardy, A. E. Ingham** and **G. Pólya.** (Roy. Soc., Proc. 113. pp. 542–569, Jan., 1927.)

1250. *Composition of Steady Plane Motions of a Liquid.* **A. Masotti.** (Comptes Rendus, 184. pp. 71–73, Jan. 10, 1927.)—Shows that the only steady plane motion that can be compounded with the flow past a cylinder, is the one which circulates irrotationally round it. **W. G. B.**

1251. *Flow Across a Circular Orifice.* **R. Mazet.** (Comptes Rendus, 184. pp. 73–75, Jan. 10, 1927.)—Extends the results of previous papers [see Abstract 872 (1927)] to a circular orifice. **Errata** (*ibid.*, p. 788, March 21, 1927). **W. G. B.**

1252. *Aerial Wave-Forms.* **T. Vautier.** (Comptes Rendus, 183. pp. 1267–1269, Dec. 20, 1926.)—Using a method previously described [see Abstract 2421 (1924)], the wave-forms of sounds produced by the explosion of black powder and of guncotton respectively are determined at the point of departure and at various points over a course of 16 kilometres. The appearance in the early stages and the disappearance at greater distance of a relatively sharp break intermediate between the wave-front and the summit, most marked in the case of guncotton, is noted and discussed. The wave-forms produced by the two explosives tend to increasing similarity with greater distance of travel, particularly after about 7 kilometres. A. B. C. L.

1253. *Forms of Explosion Waves.* **T. Vautier.** (Comptes Rendus, 183. pp. 1335–1337, Dec. 27, 1926.)—Experiments are carried out on lines similar to those previously referred to [see preceding Abstract], using the discharge of a pistol as the source of explosion waves. A graphical method for representing the damping effects noted is described. A. B. C. L.

1254. *Mechanical Properties of Rubber Cord.* **I. F. Morrison.** (Roy. Soc. Canada, Trans. 20. 2. pp. 385–394, 1926.)—The present paper deals with some preliminary aspects of the problem of developing a satisfactory method of determining the loss of energy of impact due to absorption by a rubber shock absorber cord. Mathematical considerations of the problem are included, together with a note on the manufacture of the cord and of the apparatus and technique employed for the experiments. The results of the experiments on the variation of hysteresis loss due to different rates of loading are shown graphically, and the hysteresis loss seen to decrease as the rate of loading increases. When a load is applied to the cord there is a sudden stretch followed by a slow additional stretch with time. It is the latter, equivalent to a sort of plastic deformation, which recovers with time when the load is released and causes the hysteresis loop. As the rate of loading is further increased the hysteresis losses again increase. The causes of energy loss are discussed. H. H. Ho.

1255. *Modulus of Torsion and Tensile Strength for Single and Multiple Crystal Wires.* **J. Königsberger.** (Zeits. f. Physik, 40. 10. pp. 729–741, 1927.)—In suspension systems for which the turning moment increases proportionally with the mass, it is desirable that the ratio tensile strength to modulus of torsion of the suspension should be as large as possible. These constants have been determined for wires of certain metals of high atomic number, and for a number of other substances including quartz glass. Tungsten is found to give one of the highest values for the ratio mentioned, and the constancy of its zero setting and its commercial availability make it most suitable for suspension purposes. The values of the constants are discussed in relation to the heat treatment and crystalline character of the wires used. Quartz glass behaves as a finely crystalline wire. W. S. S.

1256. *Molecular Theory of the Solid State.* **A. Smekal.** (Zeits. techn. Physik, 7. 11. pp. 535–544, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926. Phys. Zeits. 27. pp. 839–844, Dec. 15, 1926.)—A discussion of the work of some three dozen papers on crystal structure and related topics. W. H. Ge.

1257. *Crystal Structure of Gallium.* **F. M. Jaeger, P. Terpstra and H. G. K. Westenbrink.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1193–1217, 1926.)—Gives details of the preparation of pure gallium and of the growth and the crystallographic measurement of the crystals; the latter proved to be ditetregonal-bipyramidal, $a : c = 1 : 1 \cdot 6753$. The unit cell containing 8 atoms of gallium has dimensions $a = 4 \cdot 51$ Å.

and $c = 7 \cdot 51$ Å. The possible space-groups are D_{4h}^1, D_{4h}^7, D_{4h}^{10} and D_{4h}^{16}, the latter being the most probable. The proposed structure based on a simple tetragonal lattice is consistent with the crystal habit, the fact that the specific volume of solid gallium is greater than that of the liquid metal and with certain chemical properties. A very full account is included of the examination of crystals by X-ray photographic spectroscopy. W. H. Ge.

1258. *The Space Lattice of i-Erythritol.* **N. Schönfeldt, K. Herrmann and O. Hassel.** (Zeits. phys. Chem. 124. pp. 305–317, Dec. 30, 1926.)—An investigation by an X-ray method on the symmetry relations of molecules which contain two asymmetrical carbon atoms along with two corresponding elements or groups, and which are optically inactive. Generalising from the results with *i*-erythritol, these are found to possess the symmetry of a centre of inversion. [See also Abstract 1237 (1926).] G. E. A.

1259. *X-Ray Examination of the Crystal Structure of Certain Compounds.* **A. N. Sarkar.** (Phil. Mag. 2. pp. 1153–1165, Dec., 1926.)—1. Catechol $[C_6H_4(CH)_2]$.—Powder photographs give space group C_{2h}^4 with 2 molecules per unit cell.

2. $K_3Fe(CN)_6$.—A thin plate with large 100 faces was examined by the Laue method. The symmetry is twofold about the C axis (monoclinic prismatic class). The final conclusion is that the space group is either C_{2h}^4 or C_{2h}^5 according as the axis of symmetry (not determinable) is single or screw, and that the molecules are asymmetric.

3. Aluminium acetylacetone $(C_5H_7O_2)_3Al$.—The Laue photograph through C face (001) shows a twofold symmetry. The final conclusions are the same as for $K_3Fe(CN)_6$. J. E.

1260. *An X-Ray Study of Isomorphism in Simple Organo-Metallic Series. Part I. The Tetraphenyls.* **W. H. George.** (Roy. Soc., Proc. 113. pp. 585–593, Jan. 1, 1927.)—The tetraphenyls of C, Si, Ge, Sn and Pb were examined by the rotating and oscillating single-crystal photographic methods; reproductions of four of the photographs are given, and tables showing the measurements of the unit cells deduced and the approximate intensities of the reflections; the length of the *a* axis increases and that of the *c* axis diminishes as the atomic weight of the central fourth-group atom increases; there are two molecules in each unit cell. The reflections from planes having indices $(h + k + l)$ odd (*i.e.*, those absent for a simple body-centred lattice) are weak for the heavy grouping elements, but get progressively stronger with decrease in the atomic number of the grouping element; this shows the dominating influence of the heavy metal atoms. The molecules lie very nearly in the {110} planes, consistent with the marked development of the {110} faces; the space group is D_{2d}^4, but the structure approximates very closely to space group D_{4h}^{15}, No. 137 in the tables of Astbury and Yardley. The general conclusions as to the structure are shown in a diagram. The question as to whether the carbon compound is really isomorphous remains open, though there is no evidence against it. H. N. A.

1261. *Structure of Phenacite, Be_2SiO_4.* **W. L. Bragg.** (Roy. Soc., Proc. 113. pp. 642–657, Jan. 1, 1927.)—Although the chemical composition is simple, the structure proved to be unexpectedly complex. The symmetry of the structure imposes no limitation on the position of the seven atoms, and 21 parameters are required to define the structure. The SiO_4 group has been assumed to have the O atoms at the corners of a tetrahedron surrounding the Si atom, as in the other orthosilicates, and various possible configurations are tested by their capacity to explain the reflecting powers of the crystal planes. The approximate solution obtained is adjusted by trying the effect of small changes in the 15 parameters which determine the 15 positions of the Si and O atoms, the scattering effects of which are very much greater than that of the Be atom, so that the latter is not of great importance. Observations of reflecting power were expressed as absolute values, and interpreted by means of Darwin's formula for an imperfect crystal [see Abstract 1618 (1922)]. Phenacite has an axis of threefold symmetry and a symmetry centre characteristic of the hexagonal alternating class. Measurement of spacings shows that it is based on the space group C_{3i}^2, the identity period along the trigonal axis is $8 \cdot 22_8$ Å., the unit cell is a rhombohedron with sides $7 \cdot 684$ Å. and volume $366 \cdot 2$ Å.^{3}, and with six molecules inside it. Details are given of the final structure arrived at, which is illustrated by means of diagrams, and a table shows the values of F obtained by calculation and by observation of the reflections from different crystal planes; these agree pretty satisfactorily. Differences may be due to the action of the beryllium atoms. H. N. A.

1262. *Form and Energy of Crystalline Sodium Nitrate.* **J. Topping and S. Chapman.** (Roy. Soc., Proc. 113. pp. 658–673, Jan. 1, 1927.)—Since the authors' paper [see Abstract 1750 (1926)] dealing with carbonates and nitrates of the calcite class was published, Lennard-Jones and his collaborators have given data concerning the " intrinsic " repulsive forces for many of the ions in these crystals. In the latter investigation the distance, *b*, from the C to the O atom was estimated as 1·08 Å. [see Abstract 2759 (1926)], while the authors, neglecting the repulsive forces, obtained a value 0·92 Å. In the present paper the similar difference between the two values of *b* the distance from N to O in $NaNO_3$ is investigated, the potential energy due to the repulsive forces is calculated in terms of the force constants and force indices of the ions, the distance *b* and two parameters λ and t. Values of the total potential energy are then calculated for given values of *b*, for a series of values of λ and t, and curves of equal potential energy are plotted in the λ, t diagram for each value of *b*; from these the λ, t values for minimum potential energy can be deduced for the different *b* values, and a curve of minimum potential energy drawn. The results of observations, however, did not fall on this curve, but it was found that certain changes in the force constants which are probably admissible give excellent agreement between theory and observation, the corresponding value of *b* being 0·97 Å.

H. N. A.

1263. *Molecular Combination and Band Spectra.* **H. Ludloff.** (Zeits. f. Physik, 39. 7–8. pp. 528–546, 1926.)—Studies the union of the atoms of diatomic molecules in relation to the rotational and vibrational spectra. The forces uniting the parts of the molecule shortly before it breaks up owing to its own rotation, or through the vibrations of the nuclei, are specially considered, and two criteria are established with the help of which it is possible to determine in which state of rotation, or in certain cases in which state of vibration, the disintegration of the molecule and therefore the breaking off of the band spectrum is to be expected according to the theory. A comparison with the results of observation on various compounds shows good agreement. H. N. A.

1264. *A Possible Explanation of the Tetrahedron Numbers in the Natural System of the Elements Related to the Atomic Structure.* **H. Stintzing.** (Zeits. f. Physik, 40. 1–2. pp. 92–106, 1926.)—The numerical relations to which attention was called in a previous paper [see Abstract 466 (1926)] led to a tetrahedron scheme for the structure of the atomic nuclei, which was put forward as a deductive working hypothesis without reference to the forces inside the nucleus. The tetrahedron scheme is now enlarged to include the whole of the electrons contained in the atom. It appears to be contemplated that the electrons may move in certain orbits, and the name "electron" seems to be synonymous with "electron orbit." The diagrams which appear in the original paper are only intended to indicate qualitatively a scheme of symmetry which would make statical stability possible, though the actual structure may be a dynamical one. The four protons and four electrons which form the helium atom are shown at alternate corners of a cube, so that the protons are at the corners of one tetrahedron and the electrons at the corners of an "opposite" tetrahedron. Similar diagrams are given for an α-particle and for Li6, Li7, Be9, $B_0$11, C12, F19 and N20. The diagrams are in no sense to be looked upon as models, but it is interesting that the scheme appears to exclude the existence of elements with the masses 2, 3, 5, 13 and 21; the existence of an element with atomic number 93 appears probable. H. N. A.

1265. *Structure of the Electronic Groups in the Atom.* **H. Lessheim** and **R. Samuel.** (Zeits. f. Physik, 40. 3–4. pp. 220–236, 1926.)—Recently Samuel and Markowicz [see Abstract 2530 (1926)] have submitted a distribution of the electrons of the sub-groups of the Bohr-Stoner system for the elements Sc to Ni based on chemical data. This basis the present authors now deem insufficient, and accordingly have investigated the problem anew from the spectroscopic standpoint. Although in general the separate terms do not admit of a definite distribution, this has been rendered possible by means of a new assumption for the arrangement of the fundamental term—apart from a principal exception in the middle of every period. A system has thus been obtained of extraordinary symmetry, which affords a simple rule for regular, reversed and partially reversed terms, and which explains without limitation the chemistry of the elements. Suitable application to the series of elements Sc to Ni leads also to a system which possesses the same symmetrical characteristics, renders the correct regular and reversed fundamental terms, and enables the complex system of valency numbers to be understood. H. H. Ho.

1266. *The Symmetry of Sylvine and the Nature of the Etch Figures.* **K. F. Herzfeld** and **A. Hettich.** (Zeits. f. Physik, 40. 3–4. pp. 327–330, 1926.)—A reply to remarks by J. J. P. Valeton on a previous paper by the authors [see Abstract 2527 (1926)]. The right and left groups of the hexakis-octahedron surfaces are stereochemically different, and it is therefore possible to differentiate between them by means of an optically active material. Valeton's statement that from the viewpoint of the existing method of judging symmetry the authors' experiments in no way prove the holohedry of sylvine is in itself correct; the correctness of this manner of regarding the subject is, however, disputed, and it is considered that a revision of the symmetry hitherto ascribed to sylvine is necessary. H. N. A.

1267. *The Spectroscopic Significance of the Magneton Numbers in the Iron Group.* **O. Laporte** and **A. Sommerfeld.** (Zeits. f. Physik, 40. 5. pp. 333–343, 1926.)—A brief historical review of the subject is first given with reference to Sommerfeld's earlier paper [see Abstract 213 (1924)]. It is then shown that while Hund only considered the deepest term level in his spectroscopic determination of the magneton numbers of the rare earths, it is necessary with the ions of the iron group to take an average value over the different term levels. For both rare earth and iron groups, theory and observation best agree in the middle of the group where the fundamental state is a simple term (**S**-term). The observed values of the other elements lie, in general, between the two limit curves. The exceptions Cu'' and Ni'' may be due to a disturbance through metastable terms or to a deviation from the accepted regular and reversed terms. For multiple terms the magneton number is dependent on temperature, the regular ones having positive and the reversed ones negative temperature coefficients. Quantum mechanics leaves the results untouched, only changing somewhat the mode of formulation. H. H. Ho.

1268. *A Reply to W. Kast's Recent Criticism of the Paper entitled "The Born Dipole Theory of Anisotropic Liquids."* **G. Szivessy.** (Zeits. f. Physik, 40. 6. pp. 477–478, 1926.)—In answer to Kast's further criticism [see Abstract 549 (1927)] of the author's paper [see Abstract 50 (1926)] on the Born dipole theory of anisotropic liquids and also to his former reply [see Abstract 2770 (1926)], the author now submits data which he claims invalidate Kast's conclusions. He points out that if Kast's arguments were correct, then the electromagnetic direction effect should not exist. H. H. Ho.

1269. *Theory of the Spectra of the Diatomic Molecules.* **L. Landau.** (Zeits. f. Physik, 40. 8. pp. 621–627, 1926.)—This mathematical paper discusses the model of the diatomic molecule, considered as a rotator with an internal impulse, from the standpoint of the new quantum mechanics. Frequencies and intensities are calculated and the behaviour of the molecule in the electrical and magnetic fields (Stark and Zeeman effects of the bands) is investigated. H. H. Ho.

1270. *A Contribution to the Problem of the State of Ionisation of the Atoms in the Space Lattice of Beryllium Oxide.* **W. Zachariasen.** (Zeits. f. Physik, 40. 8. pp. 637–641, 1926.)—In a previous paper the author came to the conclusion from the intensities of the X-ray reflection lines that BeO crystals are built up of neutral atoms and not of ions. In a recent paper A. E. v. Arkel [see Abstract 2764 (1926)] has shown that these intensities, in the cases of TiN and AlN, which had previously been considered to prove the existence of neutral atoms, can be explained alternatively by an ionic lattice if the effect of the extension in space of the electrons on the scattering power of the atoms is considered. The interference intensities have been calculated assuming that the radius of the ion O^{--} is 0·867 Å. (Grimm) and that of the ion Be^{++} 0·25 Å.; the radius of action in the latter case is 0·34 Å. It is shown that the observed intensities can be explained just as well by means of an ionic lattice as on the assumption of neutral atoms. In a supplementary note a very recent paper by A. Claassen confirming the above result is referred to, the value of the parameter u, which is given by him as 0·39, is criticised. H. N. A.

1271. *Significance of Molecular Spectra. Part I.* **F. Hund.** (Zeits. f. Physik, 40. 10. pp. 742–764, 1927.)—The general aim of the work is to obtain a qualitative understanding of those traits in band spectra which arise from the motion of the electrons. As analogue to the many-atomed molecule, a system of one degree of freedom is considered, in which the potential energy is assumed to have several minima. It is shown to be possible to correlate the stationary states of such a system with those of component systems which supervene if the minima are an infinite distance apart or if the potential energy is infinite in between them. Corresponding to this relationship, there exists an adiabatic relation between the stationary states of a many-atomed molecule, those of two separated atoms or ions, and those of a single atom formed by coalescence of the nuclei. This forms the basis of a qualitative term scheme for the molecule and leads to certain suggestions concerning "polar molecules" and "ion lattices." W. S. S.

1272. *Electronic Structure of the Atom and the Quantum Theory.* **A. Sommerfeld.** (Manchester Phil. Soc., Mem. 70. pp. 141–151, 1925–1926.)—A discourse. Though the electron has a diameter of about 1/100,000 of the diameter of the atom, and should, considered as a moving point, have only three degrees of freedom, it requires four quantum numbers to define its orbit, instead of three, because it has angular momentum and magnetic moment. The energy difference between the two highest levels on the L shell (and similarly on others) are accounted for by the relativity theorem, since the mass of the electron changes with its velocity. Every time a shell is completed at any stage in the periodic system, the angular momenta in it are balanced in such a way that the resultant angular momentum of the shell is zero. The numbers of the electrons in the sub-groups of the shells have been determined by Stoner and Main Smith. The most stable state of the palladium atom resembles that of helium, the 18-shell of Pd being really closed. That is not so with Ni and Ag, which are more stable in other states. When silver gives up one electron, it passes into the Pd-configuration, and chemically no further electron can be detached from that completed shell. From copper we can take not only the valency electron, but we may break into the underlying shell of Ni and remove another electron; from gold three electrons can be removed. The four electrons of the sub-groups, two n_{11}, two n_{21}, may formulate a 4-shell as in C, Si, Ge, Sn, Pb. These substances form tetrahedral crystals; in diamond each C-atom is surrounded by a tetrahedron of other C-atoms, and that is so also in Si and in the compound carborundum. But there is another

type of tetrehedral structure, that of the wurtzite modification of zinc sulphide; in this each S is still surrounded by a tetrahedron of Zn, and *vice versa*, but the positions are different. That suggests the 4-shell of the periodic system, and there is a tendency of the neighbouring elements of the system to pass over into this 4-shell, as there is for the 8-shell and the 2-shell (Sommerfeld and Grimm). Boron nitride, hard like diamond, is such a compound; the bonds are chemical as in diamond, not polar.
H. B.

1273. *Electron Distribution in the Atoms of Crystals—Sodium Chloride and Lithium, Sodium and Calcium Fluorides.* **R. J. Havighurst.** (Phys. Rev. 29. pp. 1–19, Jan., 1927.)—The application of the correspondence principle by Epstein and Ehrenfest [see Abstract 1812 (1924)] to Duane's quantum theory of diffraction leads to the conclusion that the electron density at any point of a unit cell may be represented by a Fourier series. If the atoms are assumed to possess spherical symmetry, the number of electrons in a spherical shell of radius r and thickness dr is $U \,.\, dr = 4\pi r^2 \rho \,.\, dr$. Curves are given which show the variation of electron density along the cube edges of NaCl, LiF and NaF, and along the cube diagonal of CaF_2. U-curves for the different atoms show that: (1) ions are at the points of the lattice; (2) the sum of the radii of any two ions is approximately equal to the closest distance of approach as determined by X-ray analysis; (3) the electron distributions in Na^+ of NaCl and NaF are different, while F^- has the same distribution in the three fluorides; (4) there is evidence of shells in rough agreement with Stoner's scheme.
J. E.

1274. *Effective Cross-Section of HCl towards Slow Electrons. Comparison of Curves for HCl and Argon.* **E. Brüche.** (Ann. d. Physik, 82. 1. pp. 25–38, Dec. 16, 1926.)—An apparatus is described for determining the effective cross-section of HCl molecules with regard to slow electrons. The special difficulties encountered with this particular gas are fully dealt with. One source of error was a time variation of the value of the cross-section during a series of measurements. By using the initial values of the cross-section and also the mean values of the different series, two curves were obtained which were in such agreement that in spite of this source of error the character of the curve for HCl can be regarded as well defined. Comparison between the curves for HCl and for argon shows that they are similar in exhibiting a well-defined maximum for not very different velocities. No influence of the curve for H_2 on the curve for HCl could be found. From the similarity of the curves for argon and HCl it appears probable that the character of the cross-section curve for a compound is determined not by the constituent atoms forming the molecule, but solely by the number of the electrons in the outer layers of the molecule. [See Abstract 216 (1924).]
A. W.

1275. *Orbits and Photoradiation of Hydrogen Electrons.* **T. Engset.** (Ann. d. Physik, 82. 1. pp. 143–154, Dec. 16, 1926, and 82. 2. pp. 184–190, Jan. 12, 1927.)—These two papers continue previous work [see Abstract 303 (1927)]. The first gives a discussion of the magnitude of the damping constant β and the amplitude factor q in the equation, $V = q(\beta^2 + k^2 e^2_{mn})$, where $v/q = p$ is the specific potential decline of the displaced charge of the electron. The results obtained on the oscillation theory are in agreement with the interference phenomena. Following comes an investigation of the magnitude of charge excess q_0 corresponding to the frequency V_{mn}.

The second paper discusses briefly the results of Sommerfeld and Schrödinger, and then attempts to unite the various quantum standpoints by a suitable choice of coordinates and the assumption of mobile charges in the interior or on the surface of the electrons. Not only have stable orbits been obtained, but also the connected radiation frequencies. Detailed consideration has been given to the very probable case of the superficial charge. H. H. Ho.

1276. *Calculation of Atomic Fields.* **L. H. Thomas.** (Cambridge Phil. Soc., Proc. 33. pp. 542–548, Jan., 1927.)—The effective electric field inside a heavy atom is calculated on the assumptions that relativity corrections can be neglected, that the potential V depends on the distance r only, approaching E the nuclear charge as r tends to zero, that electrons are distributed uniformly in the six-dimensional phase space, two electrons to each h^3 of volume, that the potential is determined by the nuclear charge and the distribution of electrons. A table of results is given. A. Wh.

1277. *Electron with an Axis.* **L. H. Thomas.** (Phil. Mag. 3. pp. 1–22, Jan., 1927.)—A kinematical investigation on the basis of the restricted theory of relativity. After explaining the notation used, an approximation to the equations of motion is derived and the Abraham spinning electron discussed. This is clearly inadequate, but illustrates the reasonableness of certain assumptions. The secular changes in the electronic orbit are dealt with. The anomalous Zeeman effect is due to the magnetic moment of the electron, and if the axis of the electron precesses about a magnetic field with twice the Larmor precession the calculated doublet separations and Zeeman effect are in agreement with observation. The paper is mainly mathematical. A. Wh.

1278. *Elements of High Atomic Number.* **N. Siracusano.** (Accad. Lincei, Atti, 5. pp. 114–116, Jan. 16, 1927.)—The velocity of an electron in a circular orbit and neglecting relativity corrections is given by $v = 2\pi Ee/hn$, where e is the electronic and E the nuclear charge, h is Planck's constant, and n is the quantum number of the orbit. For $n = 1$ and for the condition that $v < c$, $Z = hc/2\pi e^2$, where Z is the atomic number. Substituting values, Z is found to be 138. The fuller calculation allowing for the variation of mass with velocity is found to give an equivalent result. A. Wh.

1279. *Atomic Numbers and Crystal Lattices.* **U. Panichi.** (Accad. Lincei, Atti, 5. pp. 123–128, Jan. 16, 1927.)—The values for Sm which is given by A^3/n for a cubic lattice, where A is the side of the unit cube and n the number of atoms contained within it, are tabulated for the alkali-halogen compounds and for certain other compounds with similar total atomic numbers Nm. Curves are given showing the relation between Sm and Nm and between a and Nm, and their detailed significance is discussed. A. Wh.

1280. *Breakdown of Atoms at High Pressures.* **P. W. Bridgman.** (Phys. Rev. 29. pp. 188–191, Jan., 1927.)—Thermodynamic evidence supports the experimental suggestion of a previous paper [see Abstract 1407 (1926)] that at ordinary temperatures sufficiently high pressures are capable of breaking down the quantum structure of atoms, reducing matter to an electrical gas of electrons and protons. We may therefore look for atomic dissociation under two sorts of conditions: high temperatures and comparatively low pressures, such as we have in the stellar atmospheres, and high pressures and comparatively low temperatures, which we may surmise we have in the interiors of stars, possibly in stars like the sun, and almost certainly in stars of the enormous density of the dark Sirius type. The possibility of two sorts of dissociation, together with the more rapid increase of pressure than density when the diameter of a star is reduced, offers the possibility of a critical condition determining whether a star is of the dark Sirius type or not.
AUTHOR.

1281. *Concentration and Identification of the Element of Atomic Number* 61. **J. M. Cork, C. James** and **H. C. Fogg.** (Nat. Acad. Sci., Proc. 12. pp. 696–699, Dec., 1926.)—When gadolinite and monazite are decomposed and the neodymium-samarium fractions separated by the usual methods, exhaustive fractionation is necessary before even the faintest line of the element of atomic number 61 is detectable. With xenotime, however, faint lines of this element are observable after a few fractionations. The element was confirmed by X-ray examination.
T. H. P.

1282. *Polymorphism of Fatty Acids.* **J. Thibaud.** (Comptes Rendus, 184. pp. 96–98, Jan. 10, 1927.)—Three polymorphic forms of the fatty acids give intervals of 1·41, 1·22 and 1·0 Å.U. per carbon atom. Since these are in the ratio sin 90, sin 60, sin 45, it is suggested that the hydrocarbon chains in the A, B and C forms are inclined at these angles to the surface of the plate on which the layers of fatty acid have crystallised, the true length of the hydrocarbon chain being constant at 1·41 Å.U. The value found by Müller, namely a length of 50·8 Å.U. at an angle of 60°, agrees accurately with that calculated for the B form, but the intervals 46·3 and 39·8 of the A and C forms differ by 4 Å.U. from the calculated values 50·8 and 36 Å.U., probably because of the anomalous disposition of the terminal groups, which affects the absolute values, but not the increments. T. M. L.

1283. *Note on the Correspondence Principle in the New Quantum Theory.* **C. Eckart.** (Nat. Acad. Sci., Proc. 12. pp. 684–687, Dec., 1926.)—By a suitable transformation of the Schrödinger wave equation, it is shown that the coordinate matrix can be represented by a series of the form $X(mn) = X_0(mn) + hX_1(mn) + h^2 \ldots$, in which $X_0(mn)$ approaches the coefficient of the $(m-n)$th harmonic in the Fourier expansion of the motion according to the older theory, when n approaches infinity. This is in accordance with the experimental evidence embodied in Bohr's correspondence principle. W. S. S.

1284. *Notes on Undulatory Mechanics.* **L. Brillouin.** (J. de Physique et le Radium, 7. pp. 353–368, Dec., 1926.)—The method of solution of Schrödinger's wave equation by successive approximations, of which the first corresponds to the "classical" quantum theory solution [see Abstract **2534** (1926)], is here presented again in a more general form. The most general type of problem soluble is investigated. Some suggestions as to the rôle of the time in the new mechanics are advanced in which physical existence is denied to the frequencies of the stationary states but retained for the optical frequencies. W. S. S.

1285. *Angle Variables and Canonical Transformations in Undulatory Mechanics.* **F. London.** (Zeits. f. Physik, 40. 3–4. pp. 193–210, 1926.)—The Schrödinger wave equation can be generated by operating on the unknown function $\psi(q)$ with the operator $H\left(q, \frac{h}{i}\frac{\partial}{\partial q}\right)$. Canonical transformations of the form $Q = F\left(q, \frac{\partial}{\partial q}\right)$ and $\frac{\partial}{\partial Q} = G\left(q, \frac{\partial}{\partial q}\right)$ are considered where naturally a relation exists between the functions F and G. The Eigenwerte of the transformed wave equation are shown to be the same as those of the original equation. The mathematical aspects of such transformations are discussed. In the case of a transformation to angle variables, the wave equation becomes a linear homogeneous equation with constant coefficients. As examples the problems of the rigid rotator and the simple oscillator are solved by first transforming to angle variables. The difficulty in the matrix mechanics that angle variables cannot be split up into matrix elements is discussed from the point of view of the wave mechanics. W. S. S.

1286. *Quantum Theory in Hydrodynamic Form.* **E. Madelung.** (Zeits. f. Physik, 40. 3–4. pp. 322–326, 1926.)—The Schrödinger wave equation for the single electron problem can by elimination of W be written $\operatorname{div}\operatorname{grad}\psi - \frac{8\pi^2 m}{h^2}U\psi - i\frac{4\pi m}{h}\frac{\partial\psi}{\partial t} = 0$. The author considers solutions of this equation of the form $\psi = \alpha e^{i\beta}$, where the real numbers α and β are both allowed to depend on the time. Substituting this expression in the above equation and separating real and imaginary parts, two equations are obtained corresponding to the hydrodynamic continuity equation and the equation of irrotational flow under the action of conservative forces, if α^2 and $-\frac{\beta h}{2\pi m}$ are regarded as the density and velocity potential respectively. A number of speculations based on this analogy are advanced. W. S. S.

1287. *Wave Mechanics of Collision.* **E. Fermi.** (Zeits. f. Physik, 40. 5. pp. 399–402, 1926.)—The methods developed by Born for applying Schrödinger's wave mechanics to the collision process [see Abstracts **2532** (1926) and **43** (1927)] are employed in the particularly simple case of a particle in collision with a rotator. The problem is analogous to that of the diffraction of a plane wave (the impinging particle) at a grating, the various types of collision, elastic, inelastic, of the second kind, corresponding to diffracted rays of different orders. W. S. S.

1288. *Fluctuation Phenomena and Quantum Mechanics.* **W. Heisenberg.** (Zeits. f. Physik, 40. 7. pp. 501–506, 1926.)—The interchange of energy between two loosely coupled similar atomic systems can be regarded as a rigorously discontinuous process or, in accordance with the correspondence principle, as analogous to the classical conception in which the energy of each system is a harmonic periodic function of the time. It is shown that the modified formulation of the latter alternative, furnished by quantum mechanics, is completely equivalent as far as observable effects are concerned, to the strict "discontinuum theory." The discussion is based on the mathematical theory given by the author in an earlier paper. [See Abstract 297 (1927).] W. S. S.

1289. *Quantum Mechanical Representation of Quantum Jumps.* **P. Jordan.** (Zeits. f. Physik, 40. 9. pp. 661–666, 1927.)—The reciprocal action between atoms coupled by radiation, collisions, etc., is described by the earlier quantum theory in terms of discontinuous quantum jumps (Sprünge). In the new mechanics, on the other hand, the reciprocal action is related to a continuous energy transfer in the form of slow surges. Taking a simple case, it is shown that the two methods of regarding the interaction cannot be discriminated empirically. W. S. S.

1290. *A New Foundation for Quantum Mechanics.* **P. Jordan.** (Zeits. f. Physik, 40. 11–12. pp. 809–838, 1927.)—The four forms of quantum mechanics hitherto developed, *viz.*, the matrix theory, the theory of Born and Wiener, wave mechanics, and the theory of the *q*-numbers, are now shown to be special cases of a more general formal theory. When combined with certain ideas due to Pauli, this new theory can be founded upon a number of simple fundamental postulates of a statistical nature. The paper is entirely mathematical. [See also Abstract 447 (1926).] H. H. Ho.

1291. *On the Derivation of the Schrödinger Wave Equations.* **E. Guth.** (Zeits. f. Physik, 41. 2–3. pp. 235–236, 1927.)—In this entirely mathematical note, the Schrödinger wave equations [see Abstract 1512 (1926)] are derived from a completely new standpoint. This is based on the close analogy postulated by de Broglie and Schrödinger as existing between wave mechanics and the Hamilton-Jacobi theory on the one hand and wave and geometrical optics on the other. H. H. Ho.

1292. *Physical Interpretation of Quantum Dynamics.* **P. A. M. Dirac.** (Roy. Soc., Proc. 113. pp. 621–641, Jan. 1, 1927.)—In the equations of the new quantum mechanics the dynamical variables do not obey the commutative law of multiplication, but satisfy instead the well-known quantum conditions; they are not ordinary or *c*-numbers, but are of a special type (*q*-numbers). Theory shows that the *q*-numbers can in general be represented by matrices whose elements are *c*-numbers (functions of a time parameter). Hitherto in obtaining physical results from the theory, special assumptions have been made, as in Heisenberg's original matrix mechanics, Schrödinger's wave representation of quantum mechanics, and Born's treatment of collision problems. Recently Heisenberg has dealt with the problem of two atomic systems in resonance, and finds the time mean energy of one of them by assuming that it is given by a diagonal element of the matrix that represents its energy; the calculated time means are what would be expected if the energy changes discontinuously from one quantised value to another.

The fraction of the total time during which the energy has any particular value can be calculated, but there is no information from the theory about the times of the transitions. The author finds that this result can be applied to any dynamical system and to any dynamical variable, so that certain questions that can be solved by the classical theory can be given definite unambiguous answers by means of the quantum theory. A general theory of such questions and the way the answers are to be obtained is worked out, showing all the physical information one can hope to obtain from quantum dynamics, and giving a general method for obtaining it, which can replace all the special assumptions previously used, and may perhaps go further. The notation employed is explained, transformation equations are obtained, some elementary matrices are dealt with, and transformation between any two matrix schemes is considered. The physical interpretation of the matrices is then dealt with, and it is shown that the method used in obtaining physical results is in agreement with the assumption formerly used that the square of the amplitude of the wave function in certain cases determines a probability.
H. N. A.

1293. *The Energy-Impulse Hypothesis of Material Waves.* **E. Schrödinger.** (Ann. d. Physik, 82. 2. pp. 265–272, Jan. 12, 1927.)—The Hamiltonian principle, from which the exact relativity differential equation of the de Broglie waves can be derived, appears to vindicate the hopes entertained by the author for the fusion of undulatory mechanics with classical electrodynamics [see Abstract 2024 (1926)]. Among the further consequences to be derived is the energy-impulse hypothesis for the total field from which the contribution of the charges, *i.e.*, of the ψ-function, to the energy-impulse tensor may be obtained. The author opines that such conclusions must be contained in the very general presentations of Klein and de Donder, and he now derives this connection in as simple a form as possible without reference to the gravitation theory and the interesting fifth coordinate. This has been done especially with regard to the very considerable gap which still yawns between the closed field theory and experience. The paper is entirely mathematical.
H. H. Ho.

1294. *The Formulæ for Compounding Velocities, Masses, Energies and Quantities of Motion in the Mechanics of Points with Variable Mass.* **A. Popoff.** (Zeits. f. Physik, 40. 1–2. pp. 134–136, 1926.)—It is shown that besides the formula in the relativity theory for compounding velocities, analogous formulæ exist for masses, energies, and so on. The geometry of Lobatchevski and the formulæ of hyperbolic functions are made use of in obtaining the results. The author has also worked out a mechanics of variable masses which, like relativity mechanics, but in a different way, satisfies the equations of the Lorentz substitutions. When the velocity approaches that of light, the transversal mass approaches the value zero, while the longitudinal mass tends towards infinity. This new mechanics seems to be similar to that of light quanta.
H. N. A.

1295. *Theory of the Ether and Atomic Interaction.* **R. Pictet.** (Arch. des Sciences, 8. pp. 293–329, Nov.–Dec., 1926.)—Properties of the ether should not enter into mathematical discussions unless the ether can be shown by some criterion to have a real existence in the same sense as other physical quantities. Such a criterion is suggested and allows the properties of the ether to be used. The ether is supposed to be an elastic gravitating medium, and the essential point of the theory put forward is that, the attraction between two atoms being Newtonian, they are only kept apart by the ether between them, and that any collision between atoms results in the generation of vibrations in the intervening ether. These vibrations are identified as heat radiation. The definitions of heat and temperature on this theory are considered at length, and it is shown that these quantities may be defined in a way which avoids apparent thermodynamic absurdities, such as Maxwell's demon. A. Wh.

1296. *Ether Drift.* **A. Piccard** and **E. Stahel.** (Comptes Rendus, 184. pp. 451–453, Feb. 21, 1927.)—The authors reply to a number of criticisms by Brylinski of their measurements of ether drift. The Brussels measurements were made under conditions (height, distance and time) where the displacement of the fringes should have been 9 km./sec., but an amount thirty times less was found. It is stated that the probable error in Miller's measurements is of the order of the quantity measured, and he found the same drift at Cleveland as at Mount Wilson. The authors state their laboratory apparatus had a smaller error than any formerly employed there. A mechanical test with this apparatus of a displacement of the mirror equivalent to that of Miller's ether drift gave an obvious movement of the fringes. Kennedy's inability to measure ether drift is said to be due to lack of precision. The authors offer to carry out further tests if facilities can be provided. R. S. R.

1297. *Experiment Designed to Test the Ether Theory of Light.* **A. H. Bucherer.** (Zeits. f. Physik, 41. 1. pp. 18–19, 1927.)—Light is propagated in a tube, the ratio of the diameter of which to its length is not greater than 10^{-4}, *i.e.*, the ratio of the orbital velocity of the earth to the velocity of light. If this tube be set at right angles to the earth's motion, a ray entering one end of the tube should, on the ether theory, not emerge at the other end. An experiment designed to test this is very briefly referred to. J. S. G. T.

1298. *The Limitation of Velocities.* **R. Bass.** (Phys. Zeits. 28. pp. 22–23, Jan. 1, 1927.)—The question of the possibility of the occurrence of velocities exceeding that of light (c) is discussed briefly in terms of the temporal relationship of cause and effect. J. S. G. T.

1299. *Hilbert's World-Function.* **E. T. Whittaker.** (Roy. Soc., Proc. 113. pp. 496–511, Jan. 1, 1927.)—The author replaces Hilbert's world-function by a more general world-function, which is a generalisation of the functions suggested by Hilbert, Lorentz and Weyl, and which permits the existence of magnetic currents, and light-pulses of finite and invariable size, in the general theory of relativity. The function proposed is the sum of three functions respectively attributable to the gravitational and electromagnetic fields and to material particles. J. S. G. T.

1300. *Deduction of Formal Relativistic Mechanics without Employing the Principle of Relativity.* **A. Popoff.** (Zeits. f. Physik, 40. 1–2. pp. 137–140, 1926.)—In continuation of previous work [see Abstract 2772

(1926)], the author deduces the relativity formula for the variability of mass of a moving particle, without employing the principle of relativity. The result is valid whether absolute or relative time be employed in the analysis. J. S. G. T.

1301. *Deduction of the Einstein Formula for the Composition of Velocities, in the Case when the Velocities are at Right Angles to One Another.* **A. Popoff.** (Zeits. f. Physik, 40. 1–2. pp. 141–142, 1926.)—Einstein's formula for the resultant, u, of two velocities u_1 and u_2 at right angles is deduced in the form $u^2 = u_1^2 + u_2^2 - u_1^2 u_2^2/c^2$, without using the principle of relativity. An algebraic relation between u, u_1 and u_2, involving no power of any of these velocities higher than the second is assumed to hold. J. S. G. T.

1302. *Variation of Mass in the Problem of Two Bodies.* **M. S. Vallarta.** (Zeits. f. Physik, 40. 11–12. pp. 893–894, 1927.)—The author briefly refers to deficiencies in the arguments advanced by v. Gleich [see Abstract 1529 (1926)] and Kudar [see Abstract 2544 (1926)] in their treatment of this matter, and points out that he has already shown [see Abstract 1874 (1925)] that when relations between electronic and nuclear masses and charges are taken into account, the calculated electronic orbits agree with those calculated by applying Sommerfeld's theory. J. S. G. T.

1303. *The Law of Conservation of Mass.* **H. Mandel.** (Zeits. f. Physik, 41. 2–3. pp. 230–234, 1927.)—The four-dimensional equation of continuity of the stationary mass-density of a system is deduced from Bianchi's identity for the case in which the world-lines of the whole material energy tensor trajectories constitute a "rigid motion," *i.e.*, what can be considered as a perfectly static system in the sense of the general theory of relativity. J. S. G. T.

1304. *Precision of Observations of Relative Gravity Compensated by Venturi's Method.* **G. Silva.** (Accad. Sci. Torino, Atti, 61. 11–12. pp. 247–265, 1925–1926.)—A comparison of the methods of Venturi and of Borrass. Mainly mathematical and giving numerous tables of observations at various Italian stations. E. F.

METEOROLOGY AND GEO-PHYSICS.

1305. *A. Ångström on "The Albedo of Various Surfaces of Ground."* **H. H. Kimball.** (Monthly Weather Rev. 54. p. 453, Nov., 1926.)—A summary is given of Ångström's paper in the Geografiska Annaler for 1925. Measurements were made with an Ångström pyranometer to determine the intensity of radiation received by a horizontal surface from above (i) and below (r). The ratio r/i is termed the albedo of the earth's surface. By tests with various filters the pyranometer was found to possess negligible selective absorption. Surprisingly large values were found for the albedo of different ground surfaces, the high figure being due to the large coefficient of reflection for red and infra-red radiation. The reflecting power of wet ground was found to be about half that of dry ground, the difference being partly due to evaporation but mainly to total reflection in the water films. The vertical component of the reflection of sky radiation from a rough water surface measured by the method used in determining reflection from the ground was found to be 10 %. The reflection of (solar + sky) radiation can also be measured by the same method, but the reflection of the former alone has been obtained only through computation based upon the above measurements. The results are compared with those derived from Fresnel's formula and the importance of these considered climatically. The transformation of energy by leaves was measured and tabulated and the effects of this in woods and forests discussed. R. S. R.

1306. *Remarks on Lindemann and Dobson's Theory of Meteorites.* **M. Radakovic.** (Meteorolog. Zeits. 43. pp. 441–455, Dec., 1926.)—When the meteorite enters the denser layers of the atmosphere the molecules of the materials in the atmosphere strike the vapour envelope and not the meteorite itself. An expression is obtained for the limiting density at which the gas envelope just forms and special values are deduced for H, He and N. For the N atmosphere, with a velocity of 4×10^6 cm./sec. and an air temperature of 220° at the level of the meteorite, the temperature of the meteorite envelope is 3420°. Oxidation as a source of heat is true only for slow moving meteorites. The author considers from his calculations that a predominant part of the meteorite is vaporised before a decrease of velocity occurs. A formula is deduced to connect the vapour pressure of the envelope of gas round the meteorite with the temperature and other observed quantities for the meteorite. The limiting velocity which must be exceeded for vaporisation to commence, in the case of a meteorite of Fe, is $1{\cdot}2 \times 10^6$ cm./sec. Values are also deduced for the density of the air, at a height where illumination commences, in terms of observed quantities. The author considers that the theory discloses a practicable way of explaining the action of the atmosphere at great heights from observation of meteorites. R. S. R.

1307. *Modification of a Frequency Curve by the Superposition of a Sinusoidal Variation on an Accidental Variation.* **G. Rempp.** (Comptes Rendus, 184. pp. 37–39, Jan. 4, 1927.)—Observations at Green Harbour, Spitzbergen, where the accidental variation of temperature in summer is feeble, yielded the probable mean error for (i) the diurnal mean and (ii) the observed temperature at each hour in July and August. The author sought to find how the differences of (i) and (ii) may be due to diurnal variation of temperature or to an increase of accidental variation. A family of curves is obtained to express the results, and it is concluded that the difference between the frequency curve of diurnal means and that of hourly values is due in part to the excess of variability which this variation bears. R. S. R.

1308. *Recorder of Frequency of Atmospherics: Its Use in Meteorology.* **R. Bureau, A. Viaut** and **A. Gret.** (Comptes Rendus, 184. pp. 157–158, Jan. 17, 1927.)—In the apparatus used each atmospheric functions a relay, and a current is conveyed through an electro-magnet to operate the recording part. A curve is traced whose ordinates are proportional to the frequency of the atmospherics. The curves between August and December, 1926, covered many types of atmospherics and many meteorological situations, but a sharp relationship is shown between the passage of surfaces of discontinuity and the evolution of atmospherics. In one striking case the atmospherics coincided exactly with the moment at which each of a series of squalls passed over. It is concluded that (i) the source of a very great number of atmospherics is in the atmosphere in the immediate vicinity of the W/T station, and (ii) registrations of atmospherics form one of the most powerful means for the analysis of the detailed structure of the meteorological discontinuities and in particular the principal and secondary cold front discontinuities. R. S. R.

1309. *Harmonic Temperature Analysis of the South Atlantic Current Circulation.* **F. Kerner-Marilaun.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 9. pp. 465–485, 1926.)—The most probable track for the general South Atlantic circulation is obtained from the Deutsche Seewarte Atlas. For 24 points, equally spaced on the ring, the corresponding mean temperatures of the sea are found for the middle month of each of the four seasons from curves of isothermals. The phase angle, mean ordinate and parameter for each of the four months are determined and from this the differences between the calculated and observed values are calculated and shown in tables. The places of maximum and minimum deviation and of rise and fall of temperature are also obtained. The effects of the Falkland Islands, Benguela, Agulhas, Guinea and other currents on the main circulation are discussed. Finally isopleths are given for the South Atlantic, Benguela, South Equatorial and Brazil currents, showing the seasonal change of temperature. R. S. R.

ASTRO-PHYSICS.

1310. *Isosceles Triangle Orbits of the Second Genus.* **D. Buchanan.** (Roy. Soc. Canada, Trans. 20. 2. pp. 275–299, 1926.)—Previous discussions of isosceles triangle orbits in the problem of three bodies have considered only Poincaré's orbits of the first genus. In this paper certain orbits of the second genus are dealt with. The paper is entirely mathematical. A. Wh.

1311. *Automatic Registration of Radiotelegraphic Signals and a New Method for Eliminating Errors of Registration in Determinations of Longitude.* **P. Vocca.** (Accad. Sci. Torino, Atti, 61. 8–10. pp. 210–228, 1925–1926.)—Describes experiments with a microphonic relay in which the diaphragm of the receiving telephone actuates a lever which in its turn opens or closes a secondary relay controlling the chronograph. The author devised an apparatus with which he claims to have achieved very satisfactory results. Full details of its construction are given in several figures, but space does not permit of their reproduction. The original should therefore be consulted. E. F.

1312. *Chromospheric Currents Above a Sunspot.* **S. R. Pike.** (Roy. Astron. Soc., M.N. 87. pp. 56–61, Nov., 1926.)—It is pointed out that Milne's theory of the support of atoms in the atmosphere by radiation pressure leads to an explanation of the observed motions of the gases above a sunspot; for owing to the reduced intensity of radiation, the partial pressure of the vapours immediately above a spot will fall almost to zero, and an inward lateral flow will thus be produced. The velocity of inflow should be equal to the average thermal velocity of the atoms; this is found to be true for the high-level Ca^+ vapour. The case of hydrogen is also considered, but with only partial success. J. E.

1313. *The Physical Nature of the Solar Corona. Part VI.* **W. Anderson.** (Zeits. f. Physik, 41. 1. pp. 51–80, Jan., 1927.)—The present paper deals with Woltjer's objection to the author's hypothesis that in the corona interior the temperature radiation of the electronic gas still plays an important rôle in addition to that of the scattered photosphere light. A new hypothesis is now submitted, wherein the enigmatic effect of the powerful electrostatic field of the corona is regarded as analogous to the Ramsauer effect. From Moore's data on the centrifugal motion of the corona matter, it is calculated that the sun loses roughly about $2\cdot76 \times 10^{36}$ electrons per sec. The consequences of this loss are discussed and the hypothesis advanced that the sun's heat is produced by the transformation of matter into energy. The paper concludes with a discussion of how the total charge of the universe remains unaltered. Ludendorff's view that the corona is an electrically neutral mixture of electrons and positive atomic ions, and Woltjer's standpoint that instead of atomic nuclei there are positive atomic ions whose vibrations lie far in the ultra-violet, are both shown to be untenable. H. H. Ho.

1314. *Relation between the Lunar Diurnal and the Solar Diurnal Magnetic Variations.* **J. Egedal.** (Terrest. Magn. 31. pp. 193–199, Dec., 1926.)—It appears that the lunar diurnal variation must be regarded as a variation of the solar diurnal variation. The solar diurnal variation shows a single maximum and minimum, but the lunar diurnal variation has a double wave and is assumed to be well represented by the 12-hour term of the harmonic formula. On the assumption that the phenomenon is due to the tidal forces it is predicted that $L/S \cos^2 \phi f(\phi) = \text{constant}$, where L is the amplitude of the 12-hour term and S that of the solar variation, and $f(\phi)$ is given by

$$f(\phi) = \frac{\int_0^{2\pi} \cos^2 (\phi + \epsilon \sin \lambda) d\lambda}{\cos^2 \phi \int_0^{2\pi} \cos (\epsilon \sin \lambda) d\lambda},$$

where ϵ is the inclination of the ecliptic, ϕ the latitude, and λ the celestial longitude of the moon. This expression is tested with all available data and is fairly well supported. A. Wh.

1315. *Two Formulæ for Planetary Motion.* **H. F. Baker.** (Roy. Astron. Soc., M.N. 73. pp. 93–104, Nov., 1926.)—Six partial derivatives of the disturbing function are expressible in terms of three component accelerations. By the elimination of the component accelerations three relations between the partial derivatives are obtained. The second formula deals with the motion of three masses C, C_1, C_2. Let the Delaunay elements of the motion of C_1 with reference to C be $l_1 g_1 h_1 L_1 G_1 H_1$ and of the motion of C_2 with reference to the centre of mass of C, C_1 be $l_2 g_2 h_2 L_2 G_2 H_2$, then $L_1 = (\mu_1 a_1)^{\frac{1}{2}}$ and $I_2 = (\mu_2 a_2)^{\frac{1}{2}}$, where μ_1 and μ_2 are perfectly arbitrary. The twelve equations of motion of the masses can then be derived. The demonstration shows the perfectly arbitrary character of the quantities μ_1 and μ_2. A. Wh.

1316. *Declinations of 486 Stars.* **B. Zaleski.** (Acad. Polonaise, Sci. et Lettres, Bull. 8a. pp. 273–302, Oct., 1926.)—This aims at the construction of a fundamental catalogue of the declinations of stars distributed throughout the whole sky, to be based upon observations made by the same observer and the same instrument in both northern and southern hemispheres, and undertaken because of the difficulties involved in the determination and elimination of systematic errors. The author has found that if the measurement errors of the zenith distances Δz can be expressed by $\Delta z = az + b \tan z$, then the declination errors $\Delta\delta$ are zero at the pole and increase linearly as the equator is approached according to $\Delta\delta = a(90° - \delta)_{\mathrm{rad.}}$; they change sign with removal of the instrument to the southern hemisphere; they must be determined from stars in + 30° to −30° from northern and southern hemispheres by the same instrument and observer. The author gives a catalogue of 486 stars at mean epoch 1926·0, observed by himself or Cichocki at Poznań; the work will be repeated at Wellington, N.Z., and finally again repeated at Poznań. A description is given of the Repsold 80-mm. meridian circle made for Szaniawski in 1911, and an investigation of its errors. A. S. D. M.

1317. *Reflection Effect in Eclipsing Binaries.* **E. A. Milne.** (Roy. Astron. Soc., M.N. 87. pp. 43–55, Nov., 1926.)—If a parallel beam of flux πS per unit cross-section is incident at angle a on the plane surface of a semi-infinite mass of material in radiative equilibrium, the radiation emerges as a diffuse beam whose intensity $I(o, \theta)$ in a direction θ with the normal is given by $I(o, \theta) = S\dfrac{\cos a\,(\cos a + \frac{1}{2})(\cos\theta + \frac{1}{2})}{\cos a + \cos\theta}$. The temperature T at the optical depth τ is given by

$$\sigma T^4 = \pi S\,(\cos a + \tfrac{1}{2})\,[\cos a - (\cos a - \tfrac{1}{2})e^{-\tau\sec a}].$$

There is a definite boundary temperature and a definite limiting temperature in the far interior. This solution for T^4 may be superposed on any other solution corresponding to radiation generated in the far interior and transmitted to the outer layers. In particular it may be superposed on the standard solution for radiative equilibrium corresponding to zero incident radiation. For an idealised model these results may be applied to the problem of the reflection of light in close binaries. When the phase is full the distribution of reflected light over the disc of the secondary is given by $I(o, \theta) = \dfrac{L_1}{4\pi a^2}\dfrac{(\cos\theta + \frac{1}{2})^2}{2\pi}$, where L_1 is the luminosity of the primary and a is the distance between the centres of the stars. The ratio s of reflected to ordinary light at full phase is given approximately by $s = \dfrac{17}{24}\dfrac{L_1}{L_2}\dfrac{r_2^2}{a^2}$, where L_2, r_2 are the luminosity and radius of the secondary.

The surface temperature of the secondary is such that T_0^4 is increased by reflection by the factor $(1 + 2s)$, averaged over the disc according to the intensity of the total radiation. The surface temperature thus increases more than would be inferred from the increase in surface brightness. Formulæ are obtained from which the reflected light and its distribution may be calculated for phases other than the full. (*Note.*—The word "light" is used here for brevity for "total radiation of all wave-lengths.")

AUTHOR.

LIGHT.

1318. *Measurement of Absorption.* **K. Schachtschabel.** (Ann. d. Physik, 81. pp. 929–951, Dec. 11, 1926.)—Detailed description, with results from seventeen glasses and two platinum films, of a photographic method of measurement of absorption throughout the spectral field. A. D.

1319. *The Absorption of Ultra-Violet Light by Copper Sulphate Solutions.* **L. Kwiecinski** and **L. Marchlewski.** (Acad. Polonaise, Sci. et Lettres, Bull. 7a. pp. 247–253, July, 1926.)—Ley and Hegge and later Mecke and Ley have shown that $CuSO_4$ in water does not obey Beer's law [see Abstract 3072 (1924)]. The authors have experimented with a number of organic substances, and found none that do not follow this law; they determined the absorption curves by Hilger's method for two solutions, one twice the strength of the other, the thickness of the first being half that of the second. The absorption curves agreed within the limits of experimental error. They find that with solutions of $CuSO_4$ with 0·1 mol. and 0·05 mol. per litre the deviation from Beer's law does not exceed the possible experimental errors, except in the case where the extinction coefficient is 0·1. For more dilute solutions deviations were observed, which are represented graphically. H. N. A.

1320. *Ultra-Red Absorption of Coloured Glasses and Salt Solutions.* **T. Dreisch.** (Zeits. f. Physik, 40. 9. pp. 714–724, 1927.)—Comparisons were made of the ultra-red absorption by a number of coloured glasses and salt solutions. The glasses examined contained iron, copper, chromium, cobalt, nickel and uranium as colouring agents. The salts used for comparison were ferrous sulphate, ferrous ammonium sulphate, chlorides of iron, copper, cobalt and nickel, chromium sulphate and uranium nitrate. The absorption bands of the glasses and solutions had the same form and positions, unless the formation of coloured complexes disturbed the system. The ultra-red spectrum can be used to determine the colouring metal salts used in the coloured glasses. F. J. B.

1321. *Refractive Index and Dielectric Constant of Red, Crystalline, Selenium.* **S. Kyropoulos.** (Zeits. f. Physik, 40. 8. pp. 618–620, 1926.)—Large red crystals of selenium were obtained by a special method, which had edges at least 2 mm. long. The refractive index was deduced from the angle of polarisation of red light from the surface of the crystal (λ about 620 $m\mu$). The largest refractive index was 2·9, the smallest 2·2. The dielectric constant was found by Stark's method, and was 7·39 for 21·7°, in agreement with Maxwell's relation. A. C. M.

1322. *Determination of the Refractive Index from Reflection Measurements in the Ultra-Red Spectrum.* **A. Krebs.** (Ann. d. Physik, 82. 1. pp. 113–137, Dec. 16, 1926.)—Experiments are described in which the nature of the dependence of the reflection on the incident angle is determined for the residual rays of $CaCO_3$, SiO_2 and CaF_2. The reflections at the transparent bodies Se, NaCl, KCl, KBr, CaF_2, follow as expected from the Fresnel formula. The polarisation angle is determined from the reflection curves, and thence by means of Brewster's law the refractive index is calculated. By combination of the two Fresnel formulæ a formula for *n* is derived which enables from analogy an independent method for the determination of *n*. The reflections of the above residual rays are then experimentally measured for certain glasses and their refractive indices determined from the reflection curves. The paper is illustrated by numerous curves and diagrams. H. H. Ho.

1323. *Distribution of Light Intensity in Astigmatic Images.* **J. S. Friedenwald.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 621–629, Nov., 1926.)—Deals specially with the sensitivity of test charts used in refraction. W. H. Ge.

1324. *Aspheric Enlarging Condenser.* **L. V. Foster.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 631–634, Nov., 1926.)—Deals with condensers having parabolic surfaces to correct for spherical aberration. Comparisons are made of desirable dimensions for enlargements from negatives of various sizes. W. H. Ge.

1325. *Analysis of an Interferogram.* **R. Kingslake.** (Optical Soc., Trans. 28. pp. 1–15; Disc., 15–20, 1926–1927.)—It has been frequently suggested that it should be possible to analyse mathematically the interferometer pattern produced by a lens, in order to obtain a measure of the aberrations from the coefficients of the terms in the various orders of x and y. x and y are here the coordinates of a point on the interferogram, whose optical path difference relative to the central ray of the lens is known at once by counting the fringes. This method has now been tried several times, using the utmost experimental precautions to secure accuracy, but the figures do not agree very closely with those obtained for the same lens under identical conditions by the oblique Hartmann test. Possible reasons for this disagreement are suggested. Author.

1326. *An Accurate Method of Ascertaining the Position of the Focal Point of an Optical System.* **C. Beck.** (Optical Soc., Trans. 28. pp. 37–40; Disc., 41–42, 1926–1927.)—A simple and accurate method of finding the positions of the foci of different zones of microscope object glasses is described. It consists essentially in placing a diaphragm with two slit apertures behind the object glass to be tested, the directions of the slits being at right angles to one another, and finding the position where the images form a symmetrical cross. Results of measurements by this method of the zonal aberrations of apochromatic microscope object glasses are given. Author.

1327. *Temperature and Pressure Regulation in Prismatic Spectrographs.* **T. R. Merton.** (Roy. Soc., Proc. 113. pp. 704–708, Jan. 1, 1927.)—Displacements of spectral lines due to changes of temperature of the dispersing apparatus and the air in a spectrograph have long been known and many arrangements to overcome them described. The effect of change of pressure on the refractive index of the air has not received the same attention; but it is now shown that 1 cm. change of pressure may produce a shift of about 0·4 Å. A thermostatic box to provide constant temperature air round the prisms of a spectrograph is described and illustrated, the main body of the instrument being shut off from convection currents. To allow for change of barometric pressure, the spectrum is displaced an appropriate amount by means of a plane parallel plate of glass mounted within the instrument, close to the slit and capable of rotation by a micrometer screw. F. S.

1328. *Stray Light and Depolarisation Measurements.* **J. Cabannes.** (J. de Physique et le Radium, 7. pp. 338–342, Nov., 1926.)—The numerical values of depolarisation of light diffused by gases measured by the author and others are generally less than those of other physicists. The criticism of Ramanathan and Srinivasan that the results were vitiated by stray light are here dealt with, and it is shown that the effect would be in the wrong direction. A discussion is then given of the recent results of measurements on various organic vapours. W. H. Ge.

1329. *Relations between Rotatory Power and Structure in the Sugar Group. Part I.* **C. S. Hudson.** (Bureau of Standards, Sci. Papers, No. 533. pp. 242–384, 1926.)—In 1909 a beginning was made in correlating the structures of sugars with their rotatory powers by the author's application of van't Hoff's hypothesis of optical superposition to the sugars and various of their derivatives. This method of correlation was extended in numerous subsequent articles to the lactones, the amides and phenylhydrazides, the compound sugars and glycosides, and many other optically active substances. The method and its results and the new experimental data obtained in the course of these researches have come into extensive use in the fields of organic chemistry and stereochemistry. In the present work the author's various articles have been systematically arranged and republished, either in full or with some condensations. It is hoped that the orderly presentation of the subject will assist research workers in the use of this new method of investigation in stereochemistry. Author.

1330. *Polarisation of Fluorescence and Mean Life of Excited Molecules.* **F. Perrin.** (J. de Physique et le Radium, 7. pp. 390–401, Dec., 1926.)—The fluorescent light of solutions is in general partially polarised. Assuming that the excited state has a mean life t, we can calculate from the Brownian rotation the effect of the viscosity η on the percentage polarisation p by means of the formula :—

$$p = p_0/1 + (1 - p_0/3)\frac{RT}{V\eta}t,$$

where V is the volume of N molecules, and p_0 is the percentage polarisation on the assumption that the molecules do not rotate. For fluorescein in a mixture of water and glycerine this works out to be $t = 0{\cdot}43 \times 10^{-8}$ sec.; for fluorescence in water $t_0 = 0{\cdot}65 \times 10^{-8}$ sec. The output of fluorescence p is also given by $t = pt_0$, where t_0 is the mean life if every return to the unexcited state gives rise to a fluorescent emission. This last can be determined indirectly by measuring the intensity of an absorption band corresponding to the fluorescence. J. E.

1331. *Polarisation by Electron Impact.* **J. A. Eldridge** and **H. F. Olson.** (Phys. Rev. 28. pp. 1151–1156, Dec., 1926.)—When the spectrum excited by low velocity electrons in mercury vapour at low pressure is observed from a direction normal to the electron beam, many of the lines are found to be polarised (Ellett, Foote and Mohler, and Skinner).

Except when the excited atom is in a state having a minimum value for j, the usual theory predicts such polarisation, and further indicates that the polarisation (electric vector) should be parallel to the electron stream for lines which have $\Delta j = \pm 1$ and normal to the electron stream when $\Delta j = 0$. The observation shows that for the first subordinate series the polarisation is in accord with this theory. For the second subordinate series the polarisation is always much weaker, and the indication is that the sense of this polarisation is not in agreement with that predicted by theory. [See also Abstracts 999 (1926) and 656 (1927).] AUTHORS.

1332. *The Stark-Lunelund Effect.* **A. Weigl.** (Ann. d. Physik, 82. 1. pp. 1–15, Dec. 16, 1926.)—Stark found in 1906 that light sent out by canal rays is partly polarised in respect to the direction of motion of the rays. His results were criticised by Hall, but Stark and Lunelund [see Abstract 1044 (1915)] repeated the experiments in a quantitative manner. The optical treatment of the matter by Stark and Lunelund most carefully eliminated all sources of error. They observed that oscillations parallel to the direction of velocity of the canal rays are 20–25 % more intense than at right angles thereto. Further, they found an increase in the intensity ratio J_p/J_s from H_γ to H_α. In the present paper the following are the chief points considered after fully describing the experimental arrangements: Dependence on pressure and tension; polarisation at different distances from the kathode; polarisation of canal-ray light, gaseous mixtures in the discharge space and hydrogen in the observation space. A. E. G.

1333. *Polarisation of Canal-Ray Light.* **R. Döpel** and **R. v. Hirsch.** (Ann. d. Physik, 82. 1. pp. 16–24, Dec. 16, 1926.)—From the described experiments it is concluded that the polarisation of canal rays depends in the first line on the nature of both of the gases which are shot into one another. In the absence of active gas it generally fails. A. E. G.

1334. *An Experimental Test of the Ballistic Hypothesis.* **G. Wataghin.** (Zeits. f. Physik, 40. 5. pp. 378–398, 1926.)—The experiment consisted in testing the law of reflection for the light thrown by a canal-ray particle on to a reflecting surface at rest. Comparison of experimental results with measurements of the Doppler effect of a moving terrestrial source of light by means of Majorana's interferometer leads to refutation of the ballistic theory of reflection. It is deduced that the principles of Huygens and Fermat cannot be applied to any "ballistic" optics of moving bodies. This deduction is strongly confirmed by conclusions drawn from observations of double stars [see Abstract 361 (1927)]. Attention is also drawn to the inadequacy of Stark's experiment [Ann. d. Physik, 77. 16. 1925]. E. F.

1335. *Magnetic Double-Refraction in Liquids. Part I. Benzene and its Derivatives.* **C. V. Raman** and **K. S. Krishnan.** (Roy. Soc., Proc. 113. pp. 511–519, Jan. 1, 1927.)—Cotton and Mouton discovered in 1907 a feeble double refraction in liquids exposed to a strong magnetic field. This effect is negligible in aliphatic hydrocarbons, but measurable in benzene. Langevin explains this effect as due to the orienting action of the field on molecules which are magnetically and optically anistropic, and connects the absolute value of the Cotton-Mouton constant with the values of the refractivity and magnetic susceptibility along three perpendicular axes. The authors now proceed to deduce values for the optical anisotropy from the degree of depolarisation of scattered light. A value for the ratio of the magnetic susceptivity of benzene in directions parallel and perpendicular to the plane of the ring, is deduced from the Cotton-Mouton constant for this hydrocarbon, and the values for nine derivatives are then calculated successfully from the formula

$$C_m = \text{constant} \times \frac{(n_0^2 - 1)(n_0^2 + 2)}{n_0}\sqrt{\delta},$$

where the constant is given by the data for benzene, and the value of the optical anisotropy δ is deduced by two alternative formulæ from the depolarisation of scattered light, the magnetic anisotropy being assumed to be the same as in benzene. T. M. L.

1336. *Rotatory Power as a Function of Hydrogen-Ion Concentration: Malic Acid.* **E. Vellinger.** (Comptes Rendus, 184. pp. 94–96, Jan. 10, 1927.)—The course of the curve of rotatory powers can be calculated on the assumption that specific rotatory powers $[\alpha]_{5780}$ for the undissociated acid H_2A, the univalent anion HA^- and the bivalent anion A^{--}, are $+25°$ $+143°$ and $+135°$. The curve shows a point of inflexion at a hydrogen-ion concentration very near to the value $p_H = 3{\cdot}46$, which corresponds to the dissociation of the first hydrogen ion, but no marked change occurs at the point $p_H = 5{\cdot}05$ which corresponds to the dissociation of the second hydrogen ion. T. M. L.

1337. *Differences in the Time Lags of the Faraday Effect behind the Magnetic Field in Various Liquids.* **J. W. Beams** and **F. Allison.** (Phys. Rev. 29. pp. 161–164, Jan., 1927.)—Plane-polarised light from a zinc spark was passed through two liquid cells in succession. At the same time the current impulse through the spark passed through leads of variable length to oppositely wound solenoids surrounding the cells, where the magnetic field rotated the plane of polarisation of the light. By a proper adjustment of the positions of the cells and of the length of the lead wires it was possible to secure equal and opposite rotations of the plane of polarisation in the two cells. Another liquid was then placed in one of the cells and its position changed until again the rotations were balanced. The distance the cell had to be moved, divided by the velocity of light, gave the difference in the time lag of the Faraday effect in the two liquids. The lag in carbon bisulphide behind that in hydrochloric acid was $0{\cdot}3 \times 10^{-9}$ sec. The lags in the following liquids behind that in carbon bisulphide were found to be (in 10^{-9} sec.): carbon tetrachloride 1·1; water 1·1; benzene 1·9; xylene 2·1; chloroform 2·4; toluene 2·5; amyl alcohol 4·0; bromoform 4·1. The precision of the results is about $0{\cdot}3 \times 10^{-9}$ sec., depending somewhat upon the liquid. AUTHORS.

1338. *Anomalous Rotatory Dispersion in the Ultra-Violet of Aqueous Solutions of Tartaric Acid containing Boric Acid.* **R. Descamps.** (Comptes Rendus, 184. pp. 453–455, Feb. 21, 1927.)—Three dilute solutions of tartaric acid containing an exact equivalent or a slight excess of boric acid showed anomalous rotatory dispersion in the ultra-violet. This result does not prove that borotartaric acid exhibits anomalous dispersion since this acid is liable to dissociate again into boric and tartaric acids unless a large excess of one component is present. T. M. L.

1339. *Ionic Refractivity and the Scattering of Light by Gases.* **T. H. Havelock.** (Phil. Mag. 3. pp. 158–176, Jan., 1927.)—The refractivity of gases is considered when the constituents of the molecule are treated as isotropic resonators in fixed relative positions in the molecules; formulæ are given for straight-line and triangular configurations. The gases specially examined are HCl, HBa, H_2S, H_2O, CO_2 and CS_2. In addition to the refractivity, use is made of values of the ratio of two components of light scattered at right angles to an incident beam. Values of the refractivities of the hydrogen and chlorine constituents are deduced for HCl and from these the values for other ionic constituents. The values obtained are $H^+ = 0{\cdot}13$, $Cl^- = 6{\cdot}14$, $Br^- = 8{\cdot}62$, $O^{--} = 2{\cdot}58$, $S^{--} = 8{\cdot}19$, $C^{4+} = 0{\cdot}045$. Certain triangular forms that have been suggested for some of the molecules are then examined. F. S.

1340. *Metrological Investigations on Some Rays of Ne and He.* **A. Pérard.** (Comptes Rendus, 184. pp. 447–449, Feb. 21, 1927.)—Particulars are given of a series of wave-length tests carried out with the help of a Michelson interferometer. A special form of lamp was used, particulars of which are given, two being filled with Ne and two with He. The results obtained for five different wave-lengths for Ne and four for He are stated and remarks on their respective suitability in metrology. R. S. R.

1341. *Entoptic Ring Systems.* **E. Waetzmann.** (Ann. d. Physik, 81. pp. 952–957, Dec. 11, 1926.)—Description and discussion of a set of diffraction rings observed within the author's own eyes on looking towards the sun or a little to one side of it. A. D.

1342. *Light Dispersion in Sulphur Suspensions.* **G. I. Pokrowski.** (Zeits. f. Physik, 40. 5. pp. 368–377, 1926.)—With sulphur suspensions produced by the action of sulphuric acid on an aqueous solution of hyposulphite the intensity of the dispersed light may be measured as a function of the size of the particles or of the time. It can be shown that the intensity of the component vibrating in the plane of the incident and dispersed ray agrees with Rayleigh's theory. The other component, vibrating perpendicularly to this plane, grows with the lapse of time more rapidly than is consistent with theory. This fact may be explained qualitatively by the action of the smaller particles. Measurements show that η, the circumference of a particle, is the following empirical function of the time t and of c, the concentration of the solution: $\eta = \eta_0^{(1-e^{-act})}$, η_0 and a being constants [see Abstract 2070 (1926)]. The paper is mathematical and contains numerous tables and curves. E. F.

1343. *Dispersion Theory of E. Schrödinger.* **V. Bursian.** (Zeits. f. Physik, 40. 9. pp. 708–713, 1927.)—The author has shown that the equation of Schrödinger can be generalised and employed for the fundamental calculation of the variations of the light waves, and can be used for obtaining the relativity generalisation for the correction. It was further shown that an expression could be obtained for the potential, depending on the time, which resulted from the disturbance of the light wave. F. J. B.

1344. *Heape and Grylls Machine for High-Speed Photography.* **W. H. Connell.** (Journ. Sci. Instruments, 4. pp. 82–87, Dec., 1926.)—The Heape and Grylls machine has been specially designed for photographically recording the movements occurring in high speed phenomena, such as the bursting of shells and shrapnel, penetration of armour plate by projectiles, recoil of guns, the action of automatic quick-firing guns, and similar subjects of investigation in practical ballistics. Many other subjects of scientific investigation will also be able to be analysed by its means. Cinema pictures can be taken by it on ordinary cinema film at any speed from 500 to 5000 per sec., either as single or stereoscopic pairs of views. The principle on which this method of rapid cinematography is based is the continuous and synchronised movement of film and lens in order that there shall be no relative movement between film and image cast by the lens. Photographs are given of the machine showing parts and of films made on it. A. E. G.

1345. *Action of Chemically Active Rays on Gelatine.* **H. Brintzinger** and **K. Maurer.** (Kolloid Zeits. 41. pp. 46–50, Jan., 1927.)—Results are given of experiments on the effect of the light from a quartz mercury lamp on gelatine, as shown by changes in the solubility in water and in the swelling capacity, the latter being determined by the increase in weight occurring when the dried gelatine is immersed in water at 20° for six hours and then dried superficially before weighing. No change in the elementary composition of the gelatine is effected by the light, but the solubility is diminished, and the swelling power, in one experiment, decreased from 1140 % to 512, 426, 380, 348, 321, 316 and 310 %, after 1, 2, 3, 4, 5, 6 and 8 hours respectively. The results in air and carbon dioxide are similar, but in an atmosphere free from oxygen and water vapour the diminution in swelling power is less than in ordinary air. Gelatine, which has been subjected to electrodialysis so that its ash-content is greatly diminished, exhibits a considerably decreased sensitiveness to the action of light, which is regarded as a function of its content of catalytically active constituents, in this case of iron. T. H. P.

1346. *A Chemical Aspect of Sulphide Sensitivity.* **K. C. D. Hickman.** (Eastman Kodak Co. Research Lab. Comm. No. 286. Phot. J. 67. pp. 34–40; Disc., 40–41, Jan., 1927.)—The suggestion is advanced that the sulphide sensitivity speck of the high-speed silver-bromide emulsion grain plays a chemical part during light exposure by serving as a halogen absorber. The reaction is of secondary order and does not involve optical sensitising. An experiment is described in which silver sulphide deposited in an unexposed photographic film is oxidised by silver bromide under the action of light and an increased yield of metallic silver produced. Because this reaction is quite different from that between bromine and silver sulphide under ordinary laboratory conditions, it is considered probable that the reaction will take place even more certainly during latent-image formation. Speculations are made concerning certain consequences of the theory. In the *Discussion*, **T. Slater Price** stated that the author had proved that silver sulphide in some way or other acted as an acceptor for the halogen, but that he differed from the latter

in the interpretation of the results. **F. F. Renwick** could not accept the author's hypotheses without fresh evidence in their favour.
A. E. G.

1347. *Sensitivity of Photographic Emulsion. Part II. Hydrion Concentration and the Silver Bromide-Thiocarbamide Complexes.* **S. O. Rawling.** (British Phot. Research Assoc. Lab. Comm. No. 59. Phot. J. 67. pp. 42–48; Disc., 48, Jan., 1927.)—The speed of an emulsion which has been digested for some time is almost instantly lowered by the addition of acid. By bringing the emulsion back to its original hydrion concentration the speed is just as rapidly restored. It is argued that these changes in speed cannot be due to the presence of a greater or less amount of silver sulphide derived from the silver bromide-thiocarbamide complexes according as to whether the emulsion is more or less alkaline. The sudden changes in sensitivity which are brought about by such changes in hydrion concentration probably have their origin in a mechanism other than that which brings about the slow changes in photographic properties normally observed throughout the digestion of emulsions. [See also Abstract 988 (1927).]
A. E. G.

1348. *Brightness of an Illuminated Sphere.* **A. Hnatek.** (Zeits. f. Physik, 40. 1–2. pp. 143–152, 1926.)—When a spherical surface is illuminated by a parallel beam of light the brightness of any part of the illuminated surface as viewed from an external point depends upon the reflection characteristics of the surface. The author investigates the three cases in which the surface is assumed to obey (*a*) Euler's, (*b*) Lambert's, and (*c*) the Lommel-Seeliger law of reflection. The forms of the lines of equal brightness (isophots) are calculated. It is shown that laws (*a*) and (*c*) lead to results which are physically without meaning if they are assumed to hold without modification for all angles of incidence and view from 0 to $\pi/2$.
J. W. T. W.

1349. *Discharge Tubes as Photometers when Filled with Noble Gases.* **H. Kniepkamp.** (Zeits. f. Physik, 40. 1–2. pp. 12–36, 1926.)—In glow discharge tubes under special conditions by radiating the kathode with ionising rays single "lightings-up" at irregular time intervals occur. The mean number of these "lighting-up" in the unit of time is proportional to the strength of the impinging radiation, when the discharge process is kept free of disturbance. In this case the temporary distribution of "lightings-up" possesses a pure chance character. The use of this kind of discharge makes possible the photometry of ultra-violet light of extraordinarily small strengths.
A. E. G.

1350. *Measurement of Absorptive Power.* **E. C. C. Baly, R. A. Morton and R. W. Riding.** (Roy. Soc., Proc. 113. pp. 709–716, Jan. 1, 1927.)—An investigation of the comparative merits of various photometers led to the following conclusions: (1) The sector photometer and the Judd Lewis sector spectrophotometer give concordant results within a range of experimental error rarely if ever exceeding ± 2 %. (2) In the visible region the photographic and photoelectric methods agree with the visual methods. The error of the photographic method (± 2 % in this region with the dispersion of a Hilger E_3 spectrograph) is probably greater than that shown by the photoelectric and less than that of the usual method. (3) In the region 240–300 $\mu\mu$ there is a definite discrepancy between the photographic and photoelectric methods, the latter giving smaller values. (4) For the nitrates a new discrepancy is superimposed in the short-wave ultra-violet. [See Abstracts 665 (1923) and 1940 (1926).] E. F.

1351. *Extinction Coefficient Measurements with Diverging Light.* **D. S. Villars.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 29–32, Jan., 1927.)—This is a mathematical investigation of the error introduced in extinction coefficient measurements when the light is divergent. It is concluded that for the light beam from a monochromator slit this error is less than $\frac{1}{4}$ % if the ratio of the total light transmitted be used instead of the ratio of intensity. F. S.

1352. *Links Connecting Fluorescence and the Luminescence of Incandescent Solids.* **E. L. Nichols.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 661–677, Dec., 1926.)—It is shown that the incandescence of white solids is a type of luminescence possessing the characteristic features of selective emission, fatigue and sensitivity to previous heat treatment. The incandescence spectra of ZnO, CaO, $CaCO_3$ and No. 3 and 13 Lenard and Klatt sulphides are shown to agree with the luminescent spectra excited by the arc or by kathode rays. Recent work by Boardman (unpublished) shows the same spectral indentity for fluorites. Reference is made to results obtained recently with Al_2O_3 and Al_2O_3 activated with Cr (ruby) [see Abstract 1873 (1922)] to bring out the relative functions of the base and activator. The effect of the activator is a marked enhancement at temperatures below 1400° C. and a tendency to suppress the luminescence due to other sources. (Above 1400° both approach black-body radiation.) J. E.

1353. *Luminescence from Solid Nitrogen and the Auroral Spectrum.* **L. Vegard.** (Nature, 118. p. 801, Dec. 4, 1926.)—Polemical discussion of McLennan's recent letter to "Nature" [see Abstract 109 (1927)]. The objection to the writer's theory of the aurora that a band like N_2 from solid nitrogen is never seen in the aurora is answered by reference to the different conditions in the two cases. A number of reasons are given against McLennan's identification of the aurora line 5230 with an oxygen line. McLennan's interpretation would involve a spectrum quite different from that of the aurora. Experiment shows that with small concentration of nitrogen in neon the N_1 band approaches that of the auroral line 5577. J. E.

1354. *Extinction of Iodine Fluorescence.* **G. Ramsauer.** (Zeits. f. Physik, 40. 9. pp. 675–685, 1927.)—The sensitivity of iodine fluorescence generated by green and yellow light towards molecules of foreign gas is compared by means of a polarisation photometer. It is found to be the same for both methods of excitation within the limits of errors of observation. The same is repeated for the excitation with cadmium-sodium alloy by spectral analysis and using a Koch photometer. The extinction of members of the series within the series is compared by the excitation through cadmium, copper, mercury and sodium. The results obtained lead to the supposition that the transition probabilities of excited iodine molecules alter with the presence of molecules of foreign gases. A. E. G.

1355. *Decay of Phosphorescence of Zinc Sulphide.* **H. A. Taylor.** (J. Phys. Chem. 31. pp. 115–123, Jan., 1927.)—Experiments on the temperature effects of phosphorescence. The author refers to Perrin's form of the theory [see Abstract 106 (1923)] and various experimental work in conflict with it. The temperature coefficient of phosphorescent decay of ZnS is measured by noting the time of decay at various temperatures to a fixed brightness. The temperature coefficient is not appreciably affected by the nature of the source, but is different with different samples, appearing to decrease as the phosphorescence passes from green to red. Phosphorescence of long duration has a lower coefficient than that of short duration. The lowness of the coefficient (1·20 mean) suggests that the process is not "thermal," but "photochemical." The effect of infra-red on increasing the rate of decay is not selective, but any radiation of longer wave than the mean phosphorescent light is capable of causing a more rapid decay. It is suggested that the explanation of phosphorescence is purely "physical." J. E.

1356. *Antikathodic Luminescence of Some Organic Substances.* **J. K. Marsh.** (Chem. Soc., J. pp. 125–130, Jan., 1927.)—Goldstein [Abstracts 1644 and 1928 (1904)] distinguished three types of spectra when organic substances are cooled and bombarded with kathode rays, an initial spectrum, the chief spectrum, and a solution spectrum. Here pure substances are studied mainly visually. Fatigue and recovery after rest is noticed. The initial spectra consists of distinct bands which gradually diffuse into chief spectra of broad overlapping bands. Phosphorescence is marked. The materials fall into four classes: (1) Little or no glow; (2) continuous spectra; (3) usual fluorescence spectra; (4) banded spectra. The antikathodic luminescence agrees with the Tesla glow in vapours except for a slight shift towards the red. There appears to be a definite fixed interval between fluorescence and antilkathodic glow, indicating a fixed energy difference under the two modes of excitation. There are distinct resemblances in structure of the fluorescence, absorption and antikathodic glow. J. E.

1357. *Study of the Monochromatic Radiations of Cadmium in the Michelson and Hamy Lamps in View of their Metrological Applications.* **A. Pérard.** (Comptes Rendus, 183. pp. 1101–1103, Dec. 6, 1926.)—The best conditions of working the lamps is described (for the red rays). A number of measurements of the wave-lengths of the most monochromatic rays were made by a Michelson interferometer. At low tension the emission of the two lamps is identical. At higher tensions the Hamy shows a reversal of the red line which splits up into two components separated by 0·0012 μμ. The same phenomenon occurs with the Michelson lamp at very low pressures (< 1/10 mm). The line 508·6 μμ of the Michelson lamp agrees with the value found by Michelson; an oscillating satellite differing by a maximum amplitude of 0·19 μμ appears with long path differences. The Hamy lamp gives the same line up to 60 mm. pressure, beyond which variations come in. The lines 515·5 (Hamy) are exactly confirmed. J. E.

1358. *Investigations on the Validity of Stokes' Law for Phosphors.* **F. Schmidt** and **W. Zimmermann.** (Ann. d. Physik, 82. 2. pp. 191–200, Jan. 12, 1927.)—Gudden [Abstract 1159 (1924)] found an exception to

Stokes' rule in the α band of CaS(Bi) and SrS(Bi), etc. [compare Schmieder, Abstract 2487 (1925)]. Lenard confirmed the rule for Momentan processes: the other writers dealt with long duration processes. This work was designed to find whether the breaking of the rule is confined to the latter processes. Observations on ZnS(Cuα), CaS(Cuα) and SrS(Biα) show that for the Momentan process the law is strictly obeyed, but for the duration process (phosphorescence of CaS(Pb), etc., the phosphorescent light is of shorter wave-length than the exciting light. These results lead to the same conclusion that other evidence gives, that the phosphorescence and fluorescence centres are different. Discussing the results of Valentiner and Rössiger [see Abstract 1566 (1926)] in the sharp fall of the efficiency of fluorescence when part of the fluorescence is of shorter wave-length than the exciting light, the writers disagree with their conclusions on the ground that no distinction is made between total absorbed energy and exciting absorption. J. E.

1359. *A Method for Checking Measurements of Spectral Lines.* **C. Runge.** (Astrophys. J. 64. pp. 315–320, Dec., 1926.)—The method is an extension of the way in which equidistant ordinates are treated by the calculus of differences. In order to detect an irregularity among equidistant ordinates it is the custom to form the first and second differences. The smooth run of the second differences then guarantees a smooth run of the ordinates, while an irregularity in the ordinates causes a relatively large irregularity in the second differences. With ordinates that are not equidistant, the method must be modified. The differences must be divided by the differences of the corresponding abscissæ, and the quotients must be associated with the mean of the abscissæ. The same operation is then repeated with these values. With certain corrections of the abscissæ the second set is then plotted and serves the same purpose as the second differences in the calculus of differences. Reversing operations, the method can also be used for interpolation. AUTHOR.

1360. *Spectra of the Phosphorescent Flames of Carbon Disulphide and Ether.* **H. J. Emeléus.** (Chem. Soc., J. pp. 2948–2951, Nov., 1926.)—Records an examination of the spectra of the feebly luminous and relatively cool flame produced when carbon disulphide or ether is maintained at a temperature somewhat below the ignition point. The results, consistent with incomplete combustion, are compared with the spectra of the substances burning normally. W. H. GE.

1361. *Absorption Spectra of Alkali Halides.* **L. A. Müller.** (Ann. d. Physik, 82. 1. pp. 39–66, Dec. 16, 1926.)—Quantitative absorption spectra measurements of the alkali halides in aqueous solution and as vapours. Semi-normal solutions were employed, and the variations of the extinction coefficient with the wave-length are quantitatively worked out. The observations on the vapours were qualitative. The absorption in solution shifts towards the red in the succession F → Cl → Br → I. This also holds good for the maximum of the selective absorption by the vapour. The alkali-metal atom has a slight effect; it shifts the absorption towards the red in the succession Na → K → Cs → Rb. A. C. M.

1362. *Spectrum of Krypton in the Extreme Ultra-Violet.* **L. B. Taylor.** (Nat. Acad. Sci., Proc. 12. pp. 658–659, Dec., 1926.)—A table of wave-lengths and intensities for a number of lines in the extreme ultra-violet spectrum of krypton is given, this forming a preliminary step in the analysis of the spectrum. In contrast with argon and neon, the short wave-length resonance line of krypton has been found to be the stronger of the pair. One or two other similar points are raised.

W. S. S.

1363. *Arc and Spark Spectra in the Lower Quartz Region.* **(Miss) M. C. McDonald, (Miss) E. E. Sutton** and **A. B. McLay.** (Roy. Soc. Canada, Trans. 20. 2. pp. 313–322, 1926.)—The arc and spark spectra of the elements Y, Zr, La, Ce, Nd and Be have been measured in the region λ2300 Å. to λ1850 Å., using a small quartz spectrograph and Schumann plates. Tables of wave-lengths and intensities are given. F. S.

1364. *Infra-Red Spectra.* **H. G. Smith** and **(Miss) M. E. Westman.** (Roy. Soc. Canada, Trans. 20. 2. pp. 323–325, 1926.)—The spark spectra of Be and Au were photographed with a constant deviation glass spectrograph using neocyanine plates. Tables of wave-lengths are given and also measurements of a number of air lines, some of which have not previously been measured. F. S.

1365. *Arc and Spark Spectra of Rare Elements in the Fluorite Region.* **J. C. McLennan** and **M. J. Liggett.** (Roy. Soc. Canada, Trans. 20. 2. pp. 377–383, 1926.)—The spectrograph used was that previously described [see Abstract 258 (1921)]. A fluorite window was used between the sparking chamber and spectrograph, the former being filled with purified helium and the latter highly evacuated. The elements investigated were Y, Nb, La, Ce, Nd, Pr, Be, Sc and Au. Tables of wave-lengths and intensities are given in each case. F. S.

1366. *Line Spectra in Wave-Lengths of Several Decimetres.* **G. Mie.** (Phys. Zeits. 27. pp. 792–795; Disc., 795, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—In earlier measurements by Weichmann of the refractive index of water for wave-lengths ranging from 27 cm. to 65 cm., ten curves exhibited anomalous dispersion for several wave-lengths. This has now been shown to be due to the presence of very small traces of foreign dissolved matter, dissolved out from the glass. The curves were closely imitated by using water containing traces of $NaHSiO_3$. The results now obtained fit in with three resonance oscillations of wave-length 54·49 cm., 55·55 cm. and 56·29 cm., and besides these other absorption lines must be present; it is the purpose of later experiments to determine these. A. C. M.

1367. *Intensity Distribution in Absorption Lines.* **E. Lau.** (Phys. Zeits. 27. pp. 870–873, Dec. 15, 1926.)—Recent measurements by Burns and Meggers on solar lines show a shift redwards, the shift depending upon the intensity of the lines. To test this, the author gave plates different exposures, and found no shift in the lines due to a greater intensity. Consequently the results of Burns and Meggers were scrutinised more closely, and it was found that the shift was an approximately constant fraction of the breadth of the line. The explanation lies in the fact that the measurements were made interferometrically; then two successive wave-lengths λ_1 and λ_2 are connected with the diameters of their respective rings i_1 and i_2 by

$$\frac{\lambda_1}{\lambda_2}=\frac{1}{1-\frac{i_1^2-i_2^2}{8f^2}},$$

where f is the aperture of the lens used. Thus a symmetrical absorption line will appear shifted redwards. A. C. M.

1368. *Anomalous Zeeman Effect of the Mercury Line 5791 and Satellite.* **H. Nagaoka** and **T. Mishima.** (Imp. Acad. Tokyo, Proc. 2. pp. 383–386, Oct., 1926. In English.)—The anomalous Zeeman effect of the line 5791 and its satellite 0·124 was studied with an interferential spectroscope. The photographs required only 15–50 sec. for their exposure. The results are too detailed for abstraction. A. C. M.

1369. *Intensities of Components in the Partial Paschen-Back Effect.* **W. C. van Geel.** (Zeits. f. Physik, 39. 10–11. pp. 877–878, 1926.)—The measured intensities of the Zeeman components of the magnesium triplet $p_i d$, λλ = 3838·29, 3832·30, 3829·36, are found to be in good agreement with the intensities calculated using quantum mechanics. A. C. M.

1370. *Absorption of Solid Benzol.* **A. Kronenberger** and **P. Pringsheim.** (Zeits. f. Physik, 40. 1–2. pp. 75–91, 1926.)—The absorption spectrum of a thin layer of benzol, cooled to liquid-air temperature, was taken with a quartz spectrograph and the spectrum photometered. The diffuse bands which show up at room-temperature break up at − 180° C. into a large number of fine bands which show a striking similarity with those of the vapour. Various schemes are discussed for the interpretation of the spectrum without a decisive conclusion. J. E.

1371. *Spectroscopic Investigation of "Reaction" Light.* **K. Ljalikov** and **A. Terenin.** (Zeits. f. Physik, 40. 1–2. pp. 107–116, 1926.)—The light given out in the reaction of alkali vapours with I_2 in a vacuum was analysed spectroscopically between 9000 and 2000 Å. The principal series of the alkali metals was observed and apparently continuous bands which must be ascribed to the alkali molecules. An attempt to distinguish a radiation characteristic of the reaction itself gave negative results. The D lines are broadened and ill-defined to a greater extent than would be accounted for by the pressure and temperature. J. E.

1372. *Apparatus for Excitation of the Spark Spectra of Solutions.* **B. A. Lomakin.** (Zeits. f. Physik, 40. 7. pp. 548–550, 1926.)—The apparatus described is of the type in which the discharge takes place between drops of the solution in use. An upper chamber has a central electrode and is provided with a small hole in the centre of its rounded base, allowing drops of the solution to issue at a steady rate. Below the hole is a small capillary tube with a central platinum wire electrode reaching near to the top. The discharge takes place between the drops issuing from the hole and the drop at the upper end of the capillary and is viewed through a plane window in the wall of the main tube. [See also Abstract 2165 (1923).] A. W.

1373. *Intensity and Breadth of Spectral Lines.* **B. Trumpy.** (Zeits. f. Physik, 40. 8. pp. 594–617, 1926.)—The variation in width of the mercury line λ2537 with partial pressure of the mercury vapour has been investigated, keeping the total pressure constant. The experiments were carried out with admixed foreign gases to give a good width to the line. The width increased as the partial density of the mercury vapour increased; the results are in agreement with the results of earlier work on sodium vapour [see Abstract 541 (1926)], and with Holtsmark's coupling theory [see Abstract 542 (1926)]. The total absorption under different conditions was measured and found to be in agreement with earlier measurements by Füchtbauer, Joos and Dinkelacker [see Abstract 80 (1924)]. A. C. M.

1374. *The Series of the Bismuth Spectrum.* **V. Thorsen.** (Zeits. f. Physik, 40. 8. pp. 642–647, 1926.)—The spectrum was photographed and measured in the region from 10,000 to 1500 Å., including the ultra-violet Schumann region which had not been previously examined; a number of new lines were found, most of which can be arranged in the Kayser Runge groups, including five in the long wave-length region. Tables are given with the arrangement of terms arrived at, containing the wave numbers and effective quantum numbers of terms p_1 to p_7, $2s$ to $6s$, four bracketed under $3d$, four under $4d$ and two under $5d$. The s terms appear from their effective quantum numbers to form a series, and the series limit has been calculated and made use of in preparing the tables. Other tables show the possible combinations between the above terms and give the wave-lengths of the lines observed which are due to such combinations. Certain difficulties arise, but the proposed arrangement is confirmed by observations of Grotian of Ruark and of Sponer on the absorption spectrum of bismuth vapour. About two-thirds of the total number of bismuth lines have been included in the arrangement, including a large majority of the intense lines. The relation of the terms to the Bohr theory and the rules of Pauli and Hund are considered. It is thought that p_1 may be the term ^4S with $j = 2$; p_2 and p_3 may be ^2D with $j = 2$ and 3. Some of the other terms are also considered from this point of view. H. N. A.

1375. *Arc Spectra of Fluorine and Chlorine.* **T. L. de Bruin** (Zeits. f. Physik, 39. 10–11. pp. 869–876, 1926.)—These spectra have been searched for constant frequency differences in the long-wave region. The strongest lines of fluorine are arranged into multiplets. In the spectrum of chlorine constant frequency differences are noted, one of which appears to occur also in the Schumann region. A. C. M.

1376. *Series in the Spectrum of Argon. Part II.* **K. W. Meissner.** (Zeits. f. Physik, 40. 11–12. pp. 839–875, 1927.)—To the ten series of p-terms discovered in Part I [see Abstract 374 (1927)] are now added four series of s-terms and twelve series of d-terms. There are nearly thirty pages of tables. A. C. M.

1377. *The M-Doublet of Argon.* **W. Grotrian.** (Zeits. f. Physik, 40. 1–2. pp. 10–11, 1926.)—It is shown that the difference found by Meissner [see Abstract 2355 (1926)] of the series limits $\Delta\nu = 1423{\cdot}2$ cm.$^{-1}$ in the arc spectrum of argon, leads in its explanation as M-doublet to a screening constant $s = 7 \cdot 3$. This is in accord with the value $s = 7 \cdot 5$ calculated from the splitting up, $\Delta v = 881$ cm.$^{-1}$, of the two lowest doublet terms of the chlorine atom which was observed by Turner [see Abstract 1829 (1926)]. A. E. G.

1378. *Flash Arc Spectrum of Potassium.* **F. H. Newman.** (Phil. Mag. 2. pp. 1042–1046, Nov., 1926.)—Enhanced lines have previously been obtained by the author with an interrupted arc passed between sodium potassium alloy electrodes, and he now describes experiments with a vacuum arc discharge tube with two potassium electrodes. By means of a rotating commutator the arc when once started could be quenched and struck alternately, so that it persisted in an intermittent manner. The spectrum consisted almost entirely of enhanced lines, the arc lines being very faint in comparison. Photographs of the spectrum obtained and of the arc spectrum of potassium are reproduced. It is shown that 34·5 volts are required to produce the spark spectrum, while enhanced lines begin to appear when the impacting energy is greater than 23 volts. H. N. A.

1379. *Merton's Method of Measuring the Half-Width of a Spectral Source.* **J. K. Robertson.** (Phil. Mag. 3. pp. 147–158, Jan., 1927.)—Two methods have been used to determine the half-width, $\delta\lambda$, in Rayleigh's formula for evaluating the mass of a radiating particle in a gas at low pressure. The second, which is due to Merton, consists in obtaining with a high-power interference spectroscope two photographs of a spectral line under conditions which permit of a known intensity change. The theory of this method is here considered and a rigorous formula deduced which is compared with the simpler one used by Merton. It is concluded that a more careful test of the possible errors involved in the latter would be justified. F. S.

1380. *Intensities in the Stark Effect of Helium.* **Jane M. Dewey.** (Phys. Rev. 28. pp. 1108–1124, Dec., 1926.)—The quantum theory of dispersion may be applied to the Stark effect in a weak field by considering the atoms exposed to external radiation of zero frequency. This makes it possible to calculate the intensity of new lines appearing in the field (combination lines) from the intensity of lines appearing in the undisturbed spectrum. The theory is applied here to the helium spectrum. Measurements of the intensity of the helium lines $2P - nM$, $2P - nm$, $2S - 4M$, where $n = 4, 5, 6, 7$; $M = P, D, F$, etc., are given. The Lo Surdo method of obtaining emission in an electric field was used, with the kathode set with its surface parallel to the slit of the spectrograph. A photographic method of measuring the intensities, using a Moll photometer to measure the photographic density, was used. The intensity of the combination lines increases as the square or higher powers of the electric field, as the theory demands. The ratio of the intensity of the combination lines to the nearest lines in the spectrum emitted by the undisturbed atom is in approximate agreement with that calculated from the theory. AUTHOR.

1381. *Voltage-Intensity Relations of Mercury Lines below Ionisation.* **D. R. White.** (Phys. Rev. 28. pp. 1125–1135, Dec., 1926.)—Accelerating voltage-intensity relations have been obtained for twenty-eight lines of the mercury spectrum (between 5500 Å. and 2500 Å.) excited by electronic bombardment at potentials less than the ionisation potential. The tube in which the radiation was excited had four electrodes, hot kathode and three grids, and the observations were made by photographic spectrophotometric measurements. In agreement with the results of other workers, the minimum potential of excitation of a line is found to agree closely with the theoretical value in all cases but one. The curves representing the voltage-intensity relation for lines with a common outer orbit are found identical when the intensity scales are so chosen as to arbitrarily make the curves coincide at one point. Upward and downward breaks are found in these curves at certain critical potentials, but the character of the breaks and the potentials at which they occur change from series to series. The ratio of the numbers of quanta emitted in the lines of the triplet $2p_1 - 2s(5461)$, $2p_2 - 2s(4358)$, $2p_3 - 2s(4047)$ with an accelerating voltage of 10·2 volts was found to be 9 : 11 : 3. AUTHOR.

1382. *The Effects of Changes in Potential and Frequency on the Line Spectrum of Certain Gases.* **J. A. Swindler.** (Phys. Rev. 28. pp. 1136–1146, Dec., 1926.)—Using a Hilger quartz spectrograph, size C, spectrograms were made from electrodeless tubes containing helium, hydrogen, nitrogen, neon, xenon, krypton, mercury and chlorine. High-frequency peak voltages were computed from the equation $E = KI\sqrt{d\lambda/C}$, where K is a constant depending upon the velocity of light and the cycles per second of the generator. An electroscope was constructed and calibrated for measuring the potential over the secondary of a 25,000-volt transformer. Increasing the potential over the tube for either the 60-cycle or high-frequency currents seemed merely to intensify the lines. Changes in frequency from $0 \cdot 58 \times 10^6$ to $1 \cdot 91 \times 10^6$ produced no changes in the spectra. When the potential was kept approximately constant, marked differences were obtained, however, between the 60-cycle spectra and the high-frequency spectra (1) of a chlorine tube containing nitrogen as an impurity, (2) of a helium tube containing nitrogen as an impurity, and (3) of a helium tube containing mercury as an impurity. AUTHOR.

1383. *The Time Intervals between the Appearance of Certain Spectrum Lines of Helium and of Mercury.* **J. W. Beams** and **P. N. Rhodes.** (Phys. Rev. 28. pp. 1147–1150, Dec., 1926.)—The times between the appearance of certain lines in the visible region of the spectrum of helium and of mercury have been measured by a method previously described. The results are tabulated. The time intervals were found to be independent of the conditions of excitation of the spectrum lines and are believed to be of the same order of magnitude as the differences in the total times between excitation and emission of the various lines investigated. AUTHORS.

1384. *Band Spectra of Carbon Monoxide.* **R. T. Birge.** (Phys. Rev. 28. pp. 1157–1181, Dec., 1926.)—The known band spectra of neutral CO comprise the fourth positive group of carbon, the Ångström CO bands, the Cameron bands and the third positive group. The relation of these various systems is shown in connection with the following ionised CO band systems: comet-tail bands, first negative group and Baldet-Johnson combination bands. The fourth positive group as now analysed comprises, in addition, Lyman's fifth positive group and nearly all his unassigned bands. Full details of the analysis are given. The Ångström CO bands have as final state the initial state of the fourth group, which permits assignment of vibrational quantum numbers for the Ångström bands. Johnson has found the same relation for the Cameron bands and third positive group. These relations are discussed in detail. F. S.

1385. *Theory of Intensity Distribution in Band Systems.* **E. Condon.** (Phys. Rev. 28. pp. 1182–1201, Dec., 1926.)—A theory of relative intensity in a system of electronic bands is developed by extension of an idea used by Franck in discussing dissociation of molecules by light absorption. The theory predicts the existence of two specially favoured values of the change in vibrational quantum numbers in accord with the empirical facts discussed by Birge. A means of calculating the intensity distribution from known constants is given and semi-quantitative agreement found in the following cases: SiN, AlO, CO (fourth positive group), I_2 (absorption), O_2 (Schumann-Runge system), CN (violet system), CO (first negative group) and N_2 (second positive and first negative groups). F. S.

1386. *Electronic States and Band Spectrum Structure in Diatomic Molecules.* **R. S. Mulliken.** (Phys. Rev. 28. pp. 1202–1222, Dec., 1926.)—The present paper forms a continuation of previous work [see Abstracts 2104 (1926) and 685 (1927)] in which examples of spectra were discussed involving rotational energy terms essentially of the form $B(j^2 - \sigma^2)$. In the first part of the present paper the structures of a number of further examples involving singlet electronic states and due to even molecules are interpreted; in the second part additional examples due to odd molecules and involving doublet electronic states are treated; while in the last section the interpretations of this and previous papers are summarised. The analysis cannot be shortly abstracted, and reference should be made to the original paper. F. S.

1387. *Absorption Spectrum of Hydrogen in the Extreme Ultra-Violet.* **G. H. Dieke** and **J. J. Hopfield.** (Zeits. f. Physik, 40. 3–4. pp. 299–308, 1926.)—The "continuous" source used was the strong condensed discharge in a capillary tube. The spectrograph was a vacuum grating spectrograph, and the apparatus was itself used as the absorption vessel. The bands found are described in terms of three electron states. Two band systems are described which have as common final state the normal state of the molecule. The resonance potential of the hydrogen molecule is 11·1 volts. Two independent methods give as the work done in ionisation 4·34 volts and 4·38 volts respectively. A. C. M.

1388. *Critical Potentials and the Heat of Dissociation of Hydrogen as Determined from its Ultra-Violet Band Spectrum.* **E. E. Witmer.** (Phys. Rev. 28. pp. 1223–1241, Dec., 1926.)—A more detailed discussion is given of the matter of a previous paper bearing the same title [see Abstract 2106 (1926)]. In addition other bands corresponding to electronic transitions, of the same character as the Lyman bands are identified in the secondary spectrum of hydrogen in the extreme ultra-violet. W. S. S.

1389. *The Infra-Red Spectrum of Hydrogen.* **A. H. Poetker.** (Nature, 119. pp. 123–124, Jan. 22, 1927.)—The secondary spectrum has been extended photographically to 9300 Å. in the infra-red; about 170 lines additional to those of Allibone [see Abstract 142 (1927)] were measured; about 120 of these are above his uppermost limit. The wave-lengths of some of the more intense lines are recorded. In a pure monatomic spectrum five higher members of the Paschen series were photographed, P_δ, P_ϵ, P_ζ, P_η and P_θ, the wave-lengths agree with Bohr's formula. H. N. A.

1390. *Line Spectra of the Isotopes of Mercury and Chlorine.* **F. A. Jenkins.** (Phys. Rev. 29. pp. 50–58, Jan., 1927.)—Two sample pairs of mercury with atomic weight differences of 0·124 and 0·180 and one sample pair of chlorine with a difference of 0·097 were examined spectroscopically. An echelon (resolving power about 400,000) and a plane grating (resolving power 478,000 in the fifth order) were used. The spectra of the mercuries with the smaller atomic weight separation showed for the lines λλ5461, 4359, 4078 and 4047 no wave-length differences greater than the error of measurement (3×10^{-4} Å.). The first two of these lines, obtained, with the use of a special source from the mercuries of the greater atomic weight separation, were studied to see if differences in the relative intensities of the satellites could be brought out. None was found. The results, therefore, do not favour the isotopic origin of the satellites. The spectra of the two chlorine samples, when examined with the echelon, showed distinct evidence of differences in wave-length. The heavier chlorine almost invariably gave the smaller wave-length. The displacements were of the order of 0·001 Å., and only two or three times the error of their determination. A convenient source of the chlorine spectrum is described. AUTHOR.

1391. *Aluminium Oxide Band Spectrum.* **W. C. Pomeroy.** (Phys. Rev. 29. pp. 59–78, Jan., 1927.)—Measurement of lines in the aluminium arc spectrum has been carried out and the aluminium oxide band (λλ5200–4650) carefully investigated. A table of frequencies is given, and also formulæ covering all band lines measured so far. A new method of locating band origins and verifying the combination principle is given, which applies particularly to bands in which no perturbations are observed. The formulæ have theoretical significance. The moments of inertia of the AlO molecule for very small vibrations are $(46 \cdot 02 \pm 0 \cdot 02) \times 10^{-40}$ and $(43 \cdot 48 \pm 0 \cdot 02) \times 10^{-40}$ gm. cm.^{2} for the initial and final states respectively. A. C. M.

1392. *Oxygen Bands in the Ultra-Violet.* **V. M. Ellsworth** and **J. J. Hopfield.** (Phys. Rev. 29. pp. 79–84, Jan., 1927.)—The formula calculated by Birge for the first negative group of oxygen is

$$\nu = \frac{38308}{38108} + (887n' - 13 \cdot 4n'^2) - (1859 \cdot 9n'' - 16 \cdot 53n''^2).$$

This is based upon data published by Johnson [see Abstract 2769 (1924)]. The only transition to zero final state indicated by those data is the 6–0, and consequently there has been some doubt as to whether the first constant of the formula is correct. New photographs of this system show additional pairs of bands degraded to the red. Some of the new bands have been measured and found to represent the 7–0, 8–0, 9–0, 10–0, 9–1, 10–1 transitions as given by the formula above. The existence of the lowest final state represented by this formula is therefore established. The 0–9 band, not previously observed, is also present. Other new bands appear further to the ultra-violet. They have the appearance of belonging to the system, but are too faint to measure. It seems probable that these bands will be found to constitute from one to three progressions to still lower final states. AUTHORS.

1393. *The Many-Lined Spectrum of Sodium Hydride.* **E. H. Johnson.** (Phys. Rev. 29. pp. 85–96, Jan., 1927.)—A direct-current arc was maintained between a water-cooled iron kathode and a sodium anode in a hydrogen atmosphere up to pressures of 3 or 4 cm. With potential differences from 20 to 30 volts, a many-lined spectrum was obtained in which several bands and branches have been identified in the region between λ3900 and λ5100. Computations involving the usual quantum assumptions have led to the determination of the following molecular magnitudes:—

λ4333 Band.

Initial State.	Final State.
$I' = 3{\cdot}59 \times 10^{-40}$ gm. cm^2.	$I'' = 5{\cdot}10 \times 10^{-40}$ gm. cm^2.
$r_0' = 1{\cdot}51 \times 10^{-8}$ cm.	$r_0'' = 1{\cdot}80 \times 10^{-8}$ cm.

λ4655 Band.

Initial State.	Final State.
$I' = 3{\cdot}20 \times 10^{-40}$ gm. cm^2.	$I'' = 4{\cdot}06 \times 10^{-40}$ gm. cm^2.
$r_0' = 1{\cdot}42 \times 10^{-8}$ cm.	$r_0'' = 1{\cdot}60 \times 10^{-8}$ cm.

Some deviations from current quantum formulæ are pointed out. AUTHOR.

1394. *Band Spectrum of Calcium Hydride.* **E. Hulthèn.** (Phys. Rev. 29. pp. 97–111, Jan., 1927.)—The bands emitted by an arc of calcium burning in hydrogen at 20 mm. pressure were photographed in the 1st and 2nd orders of a large concave grating. Two groups of bands, shading towards the violet, were distinguished; the A groups with heads at λλ7035, 7028, 6921, 6903 and the B groups with heads at λλ6389, 6382. In addition there is a C group at λ3533, studied by Mulliken [see Abstract 1888 (1925)]. The A group forms a doublet series with P–Q–R branches. The B group is similar to the violet cyanogen bands with doublet P_1P_2 and R_1R_2 branches. The C group consists of a single band with P–R branches. From combinations found between P–R branches, conclusions are reached regarding spectral terms of CaH. The nuclear spacings in the CaH molecule are not in correlation with their vibration frequencies, violating a rule of Birge and Mecke. A comparison of the A group with spectra of ZnH, CdH and HgH shows several interesting parallels, confirming Mulliken's theory of these spectra. F. S.

1395. *Fluorescent and Absorption Spectra of Iodine.* **F. W. Loomis.** (Phys. Rev. 29. pp. 112–134, Jan., 1927.)—The paper is concerned with relationships of the values for the fluorescent and absorption spectra of iodine as measured by Mecke [see Abstract 2420 (1923)]. Certain lines close to λ5460 in the former spectrum are identified with definite lines in the absorption spectrum. Constants for both spectra are calculated and Mecke's equations for band heads revised. These new series of fluorescent doublets are found and formulated and their relationship to the other bands discussed. F. S.

1396. *Absorption Coefficient of Helium for its Own Radiation.* **A. Wolf** and **B. B. Weatherby.** (Phys. Rev. 29. pp. 135–140, Jan., 1927.)—The absorption coefficient of helium for its own radiation in the extreme ultra-violet was measured for various pressures. In the range of pressure from 0·016 to 0·040 mm. Hg the mass absorption coefficient was found to be $1{\cdot}24 \times 10^7$. For lower pressures the mass absorption coefficient increases rapidly with decrease in pressure. AUTHORS.

1397. *Electron Collisions in Carbon Monoxide.* **F. L. Mohler** and **P. D. Foote.** (Phys. Rev. 29. pp. 141–144, Jan., 1927.)—Critical potential measurements for CO are correlated with spectroscopic data. Observed values are: excitation, 5·8, 8·0, 10·1 volts; ionisation, 14·3 volts. The two lower values were obtained by the partial current method. Band spectra give 6·0, 8·0, 10·34 and 14·2 volts. Denoting the 6- and 8-volt collisions by *a* and *b* respectively, energy losses corresponding to successive collisions of the type *a*, *aa*, *ba*, *baa* and *bba* have a high probability while collisions of the type *b* and *bb* are relatively very infrequent. This peculiarity is also observed with the second group metals. The resemblance of CO to the second group metals is in accord with the spectral classification which makes the 6-volt level a ^3P state and 8-volt level a ^1P state. AUTHORS.

1398. *Is–md Series of Cæsium and Other Alkali Metals.* **G. M. Shrum, N. M. Carter** and **H. W. Fowler.** (Phil. Mag. 3. pp. 27–31, Jan., 1927.)—The first two pairs of the *is–md* series of cæsium have been observed in absorption by Sowerby and Barratt [see Abstract 1037 (1926)], although forbidden by the selection principle. It has now been found that they can be observed in emission in a carbon arc for a few seconds after feeding it with a salt. They then disappear, although the ordinary lines remain strong. Intermittent exposures were therefore made while observing the 6848 Å. line with a control spectroscope. Six members not previously observed in emission have been photographed and their wave-lengths found to be in good agreement with calculated values. The method also applies to other alkali metals. F. S.

1399. *Note on Some Band Spectra Associated with Silicon.* **W. H. B. Cameron.** (Phil. Mag. 3. pp. 110–115, Jan., 1927.)—The electron structure of silicon is similar to that of carbon, and the author has attempted to find band spectra from its compounds analogous with those obtained from carbon compounds. Jevons has recorded two band spectra which he attributed to silicon nitride and chloride, and assigned a third system to the oxide. The author has obtained bands with an arc burned between silicon poles in air; five or six bands were observed and the wave-lengths are given in a table. It is quite possible that these bands are due to an impurity in the commercial silicon employed, but it is suggested that this blue system of bands is due to a silicon-oxide molecule. When vapour of $SiCl_4$ was pumped through a discharge tube at very low pressure, and oxygen added in slight excess, a closely spaced series of narrow bands was obtained extending almost throughout the visible region. These were photographed, and a table gives the wave-lengths of the band heads. It is suggested tentatively that these bands may be analogous to the CO bands of comet-tails and associated bands. The SiO bands observed by de Gramont and de Watteville and investigated by Jevons may be the analogue of the fourth positive carbon bands. H. N. A.

1400. *Electric Field near the Surface of the Atoms of Certain Elements as Deduced from the Doublet Separations of their Spectra.* **N. R. Sen.** (Phil. Mag. 3. pp. 209–213, Jan., 1927.)—The explanation of the fine structure of spectral lines originates with Sommerfeld's application of relativity mechanics to Bohr's atomic structure. Landé has extended the theory to the case of optical doublets [see Abstract 2503 (1924)] and given a fairly satisfactory formula for the doublet separations of optical spectra. The author now discusses the case when the orbit of the radiating electron penetrates the core and is moving in fields of widely different strengths at the perihelion and aphelion. He particularly deals with an atom having three electrons on the outside shell and discusses data for Al, Ca, In, Th, giving an explanation of the uniformity in the values of the effective quantum numbers of the orbit and effective charges. H. H. Ho.

1401. *"Flash" Arc Spectrum of Rubidium.* **F. H. Newman.** (Phil. Mag. 3. pp. 229–235, Jan., 1927.)—An interrupted arc discharge at a low pressure in rubidium vapour gave prominence to spark lines; and in particular a group lying between λλ5525 and 3271·4 was noticed, which is thought to correspond to the krypton "red" spectrum. Using rubidium fluoride salt instead of the metal gave a spectrum intermediate between the ordinary rubidium arc and the "flash" arc. A. C. M.

1402. *Arc Spectrum of Europium between λ3100 and λ2200 I.A.* **S. P. de Rubies.** (Comptes Rendus, 184. pp. 87–89, Jan. 10, 1927.)—This is a continuation of previous work [see Abstract 138 (1927)]. A list of wave-lengths and intensities is given in this range, and the lines noted, which are given by Ennek and Haschek and by Eder, now considered to be due to impurity or which are lacking in present measurements. F. S.

1403. *Intensity of Spectrum Lines.* **T. R. Merton.** (Roy. Soc., Proc. 113. pp. 697–703, Jan. 1, 1927.)—The method now described is a modification of that previously used by Nicholson and Merton [see Abstract 1132 (1917)]. The spectrum to be measured is photographed direct with a known slit width and compared with a standard continuous spectrum—that of the positive crater of a carbon arc or of a standardised incandescent lamp—taken through a slit of known, but not necessarily equal, width and a wedge crossed with a number of equidistant clear lines in an opaque layer. The latter spectrum thus consists of horizontal lines whose number depends upon the density gradient of the wedge, distribution of intensity in the spectrum, absorption of light in the instrument and colour sensitiveness of the plate. For simple spectra, the two exposures can be superposed and the horizontal line of equal intensity to the spectrum line found by inspection. For more complex spectra, the two exposures are made on contiguous parts of the plate, which is then cut and examined with a special form of comparator which is described. F. S.

1404. *Absorption Spectra of Saturated and Unsaturated Organic Substances.* **J. E. Purvis.** (Cambridge Phil. Soc., Proc. 33. pp. 588–592, Jan., 1927.)—A discussion of some of the conditions which influence the absorption spectra of various saturated and unsaturated compounds: cyclo-hexane, -hexene, -hexanol; geraniol; geranyl acetate, butyrate, etc., and pentabromophenol, dissolved in alcohol. The vapours are examined in a quartz tube, 200 mm. long, heated in a bath; a condensed cadmium spark is used as a source of radiated energy. Some acids, oleic, stearic, etc., are also studied, the stearic acid being dissolved in ether. The results are summarised, and only partly tabulated. The shifting of the bands towards the red by weighting the molecule is observed. Specific absorption in the ultra-violet is not always governed by the unsaturated condition of the atoms of a molecule; the vapours and alcoholic solutions of iodo-derivatives of benzene and toluene showed —in previous researches—no specific absorption, whilst those of bromine and chlorine did. H. B.

1405. *Absorption Spectra of Nitrates in the Region* 300 $\mu\mu$. **R. A. Morton** and **R. W. Riding.** (Roy. Soc., Proc. 113. pp. 717–731, Jan. 1, 1927.)—Quantitative absorption-spectra measurements show that nitrates have an absorption band at 300 $\mu\mu$, $\epsilon_{\max.}$ 7–2, due to the NO_3 ion; there is also continuous end absorption from about 270 $\mu\mu$ towards the ultra-violet. The end absorption is attributed to interionic attractions. Beer's law is found to be valid for dilutions below N/10; above this there is a bodily shifting of the band towards the direction of higher extinction coefficients. There appears to be a superimposed band of selective absorption. Evidence is given that this band is due to undissociated molecules. Concentrated nitric acid and the alkyl nitrates show no selective absorption. The frequencies of the three bands deduced in the ultra-violet arc integral multiples of a band in the short infra-red due to the NO_3 group. It is suggested that light is necessary for the "activation" of the absorption. A. C. M.

1406. *X-Ray Diffraction Measurements upon Compounds in the System Soda-Lime-Silica.* **R. W. G. Wyckoff** and **G. W. Morey.** (Am. J. Sci. 12. pp. 419–439, Nov., 1926.)—Powder diffraction measurements have been made and recorded from the compounds Na_2CaSiO_4, $Na_4Ca(SiO_3)_3$ and $Na_2Ca_2(SiO_3)_3$. The powder pattern of $Na_2Ca_2(SiO_3)_3$ is richer in lines than are the patterns of the other two compounds. It resembles these others, however, in having conspicuous lines in the same places. Both the optical and X-ray diffraction results agree in assigning cubic symmetry to Na_2CaSiO_4. The unit cube contains four molecules, and has a length of edge $a_0 = 7 \cdot 49_7$ Å. The metal atoms have approximately the positions: *4b*, *4c*, *4d*, *4e*. The positions of the oxygen atoms cannot be established. Well-developed crystals of $Na_4Ca(SiO_3)_3$ exhibit forms which are apparently cubic and appear to be completely isotropic. Their powder diffraction pattern nevertheless shows a few lines which cannot be ascribed to a crystal having cubic symmetry, and which apparently do not arise from impurities. Hence it is probable that the symmetry of this substance is pseudo-cubic rather than cubic. The diffraction lines which can belong to a cubic crystal fit a cube having $a_0 = 7 \cdot 54_7$ Å. and containing two molecules of $Na_4Ca(SiO_3)_3$. These observed data are qualitatively explained if the metal atoms have, at least approximately, the following positions: $2a$, $6e$, $8e$. Even though it can scarcely furnish the correct grouping of the oxygen atoms, the preceding structure with oxygen at $12a$ ($u = 0 \cdot 30$) and $6f$ yields a satisfactory explanation of these "cubic" data. Several ways are briefly discussed for reconciling this apparent conflict between observed symmetry and calculated symmetry of atomic arrangement. AUTHORS.

1407. *X-Ray Reflection Intensities from Powdered Crystals. Part I. NaCl and Na, LiF and CaF_2. Part II. Effect of Crystal Size.* **R. J. Havighurst.** (Phys. Rev. 28. pp. 869–881, and Part II. pp. 881–890, Nov., 1926.)—A preliminary account of Part I has already been given [see Abstract 2117 (1926)]. The measurements were made by the ionisation method of the relative intensities from the different planes of powdered crystals, and were made absolute by comparison with reflections from powdered sodium chloride, assuming that the results of Bragg, Janus and Bosanquet are correct. The structure factors were calculated for different crystals; they fall upon smooth curves when plotted against sin θ, and from these can be got the atomic scattering curves. For F in NaF, LiF, and CaF_2 the curves are almost identical, but for Na in NaF and NaCl there is a marked difference, showing a difference in electron-distribution.

Part II.—A preliminary account has also been published [see Abstract 2624 (1926)]. Measurements upon large single crystals were compared with those obtained as in Part I with crystals of different degrees of fineness. Secondary extinction is not present in the powder method; primary extinction was also absent when the crystals were thoroughly ground. The single-crystal measurements for rock-salt mentioned above agreed with the author's when corrected for secondary extinction. With calcite a certain amount of primary extinction may be present even in the powder method, since it forms such perfect crystals. A. C. M.

1408. *The Dispersion of X-Rays.* **A. M. MacMahon.** (Frank. Inst., J. 202. pp. 637–655, Nov., 1926.)—A *résumé* of investigations. The equation $\mu_r = 1 - \frac{1}{2}\frac{he^2Z}{\pi m\nu^2}$, representing the adaptation of Lorentz' theory of dispersion to X-ray frequencies (ν) is introduced. And a summary of the experiments on μ_r is given with numerous references. Particular reference is made to Nardroff's application [see Abstract 579 (1925)] of the more general form of Lorentz' equation to iron pyrites

$$\delta = (1 - \mu) = \frac{Ne^2}{2\pi m}\left[\frac{K_{Fe}}{\nu^2 - \nu_{Fe}^2} + \frac{K_s}{\nu^2 - \nu_s^2} + \frac{(Ze - K_{Fe}) + 2(Z_s - K_s)}{\nu^2}\right]$$

to determine the numbers K_{Fe} and K_s of electrons in the K levels of Fe and S. J. E.

1409. *Influence of Temperature on X-Ray Interference.* **M. v. Laue.** (Ann. d. Physik, 81. pp. 877–905, Dec. 11, 1926.)—An attempt is made to calculate from Doppler's principle the interference-effect for atoms in a space-lattice when in a condition of thermal agitation. For diffuse radiation the results differ from those given previously only in that the scattered radiation should have a different frequency from the incident radiation, but this difference would not be accessible to experiment. Differences between observation and theory must therefore be explained along some other line. T. M. L.

1410. *X-Ray Spectroscopy of Pearls.* **J. Galibourg and F. Ryziger.** (Comptes Rendus, 183. pp. 960–962, Nov. 22, 1926.)—The authors have applied the methods of X-ray spectroscopy to distinguish between " real " and " culture " pearls. A beam of X-rays perpendicular to the structural planes (layers) of the pearl is reflected to give a spectrum formed of points arranged at the corners of one or more hexagons. The authors have obtained spectra, consisting of several concentric hexagons using (1) a complete pearl, (2) a fragment detached from the outside layer of a pearl, and (3) a pearl with its nucleus removed (by a special process). As the hexagonal spectrum characterises the normal incidence of the X-rays on a layer of pearl, so the binary spectrum characterises the incidence of X-rays parallel to the layers. A beam of X-rays incident normally to the structural layers of the pearl gives the same spectrum whether the pearl be " real " or " culture." To identify an " unknown " pearl, the authors make a first exposure in any direction whatever. If the pearl is a " culture " the chances are six to one in favour of a typical binary structure. If the spectrum is hexagonal, a rotation of 90° will remove any doubt, for it will still give a hexagonal spectrum if the pearl is natural; and as a final check, a spectrum of binary symmetry if the pearl is a " culture," the beam emerging with certainty in the case of 74° A. B. W.

1411. *X-Ray Spectra of the Lower Elements.* **R. Thoræus.** (Phil. Mag. 2. pp. 1007–1018, Nov., 1926.)—This is a continuation of previous work [see Abstract 1359 (1926)]. The α and β lines of the L series from Br (35) to Cu (29) have been measured with a vacuum spectrograph and gypsum crystal, and each shown to have two satellites. The L series of Ge (32) has also been measured. The Lα lines of Zn, Cu and Ni have been examined for the metal and for salts. In the case of Zn the results are alike, but changes are noted for Cu and Ni. In the case of Cu, the line is broad with diffuse edges in the case of the metal and Cu^{2}O, and a doublet for CuO and CuS. Tables of values of ν/R and $\sqrt{\nu/R}$ are given for the L series, and for a number of energy levels, and also a short description of the vacuum spectograph. F. S.

1412. *Direction Distribution of Electrons produced by Polarised X-Rays.* **F. Kirchner.** (Phys. Zeits. 27. pp. 799–801; Disc., 801, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926. Ann. d. Physik, 81. pp. 1113–1128, Dec. 11, 1926.)—Using the Wilson cloud method, the author has photographed the tracks of the Compton scattered-electrons produced by a polarised beam of X-rays. It is found that the emission of these electrons is a maximum in the direction perpendicular to the electric vector of the X-radiation. A. B. W.

1413. *The Weissenberg Röntgengoniometer.* **J. Böhm.** (Zeits. f. Physik, 39. 7–8. pp. 557–561, 1926.)—A Röntgengoniometer based on the idea of Weissenberg [see Abstract 1810 (1924)] is described. Its use for determining the lattice and the angles between the planes of a crystal is illustrated for the rhombic crystal diaspor. A detailed working out of this example to illustrate the theory of the method will be given in the *Zeitschrift für Kristallographie.* J. E.

1414. *Measurements in the K Series of Röntgen Spectra.* **A. Leide.** (Zeits. f. Physik, 39. 9. pp. 686–710, 1926.)—The measurements are made with a Seeman-Siegbahn spectrograph and a calcite grating on a large number of elements. The α_1 and α_2 lines are measured for Cu 29 to W 74, the β_1 and β_2 lines for Cu to I 53, the β_3 line for Mo, Pd, Ag, Cd, Sn; a new line β_4 was observed in Mo and Pd. The limiting frequencies were determined for Cu to Nd 60 (with some exceptions), and also for Ho 67. The paper is largely tabular, and the figures found are used for a re-examination of the energy levels, and further for calculating the limiting frequencies, the latter with the aid of measurements in the M series (for Th and U) and L series (U to Sn); for the elements of ordinal numbers below 50 (Sn) the calculations start from the K series. The agreement with other observers is good for the α lines, less so for the β lines. H. B.

1415. *Action of Magnetic Fields on Plane-Polarised Primary X-Rays.* **W. Kartschagin** and **E. Tschetwerikowa.** (Zeits. f. Physik, 39. 12. pp. 886–900, 1926.)—The action of a magnetic field on the plane of polarisation of X-rays in their passage through paraffin and iron is examined experimentally. On account of the smallness of the rotation of the plane of polarisation in paraffin the effect could not be observed with certainty. In the case of iron, however, a definite rotation was observed, but an exact estimate of its magnitude could not be obtained. A. B. W.

1416. *Secondary and Tertiary Kathode Rays due to Absorption of X-Rays.* **H. R. Robinson** and **A. M. Cassie.** (Roy. Soc., Proc. 113. pp. 282–301, Dec. 1, 1926.)—Describes the results of further measurements made with an improved form of the Robinson-Rawlinson apparatus [see Abstract 868 (1924)]. Molybdenum K-rays were used as primary X-radiation and the materials studied were Ur, Bi, W, Ce, Zr, As (as oxides), Au, Ag, Mo, Cu (as metals), Th (as nitrate), Ba (as carbonate) and Br (as NH_4Br). The results obtained for the "fluorescent" groups are discussed in particular. J. W. T. W.

1417. *The Compton Effect in Schrödinger's Theory.* **W. Gordon.** (Zeits. f. Physik, 40. 1–2. pp. 117–133, 1926.)—Dirac has calculated the Compton effect using Heisenberg's method [see Abstract 2542 (1926). That of Schrödinger has the advantage that ordinary mathematical processes are employed, and the author shows how the frequencies and intensities of the radiations due to the Compton effect can be obtained by means of this theory; they are shown to be equal to the geometrical means between the corresponding magnitudes in the "classical" theory in the initial and final states of each process. H. N. A.

1418. *The Screening Constants of the Relativity or Magnetic Röntgen-Ray Doublets.* **L. Pauling.** (Zeits. f. Physik, 40. 5. pp. 344–350, 1926.)—Previously, calculations on gyrating electrons by Goudsmit and Uhlenbeck, Bichowsky and Urey, Heisenberg and Jordan [see Abstract 2372 (1926)] have only been made for a few of the empirical results obtained for the relativity doublets of the Röntgen-ray region. It is now shown that the theory of the gyrating electron for the relativity or magnetic doublets leads to values for the screening constants of the Röntgen spectra which are in good agreement with the experimental values, and that the discrepancy found by Wentzel is incorrect and due to an error in his equations. H. H. Ho.

1419. *Energy Transformations in Certain X-Ray Effects.* **R. Glocker.** (Zeits. f. Physik, 40. 7. pp. 479–491, 1926.)—A general discussion is given of the relation between the incident X-ray intensity and the consequent ionisation current in the gas of the ionisation chamber. It is emphasised that in the neighbourhood of an absorption edge of the absorbing gas the ionisation current i is independent of wave-length, and is related to the incident intensity I_0 by the formula: $\frac{i}{\gamma . I_0} =$ constant, where γ is not the total absorbed energy but the fraction of the incident X-radiation transformed into kinetic energy of secondary electrons. A similar type of formula holds for the photographic action of X-rays. A reconsideration of Sadler's measurements of the percentage of excited atoms which emit fluorescence radiation indicates that this quantity decreases somewhat as the difference of frequency between incident and characteristic radiation increases. W. S. S.

1420. *Intensity Ratios for the Alkali Doublets.* **C. Füchtbauer** and **H. Meier.** (Phys. Zeits. 27. pp. 853–856, Dec. 15, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—Experiments were made on the influence of foreign gases on the broadening of the alkali doublet spectra. The sodium D-lines broadened when hydrogen, nitrogen and argon were separately admixed just in the same manner as the mercury line 2537. The broadening of the cæsium doublets when foreign gases were added showed that the intensity ratio of the doublets is not invariably 2 : 1, but that this ratio increased with increasing order number in the series (*e.g.*, for the third pair the ratio is 5·6 : 1). A. C. M.

1421. *Doublet Laws in the First Long Period.* **R. C. Gibbs** and **H. E. White.** (Nat. Acad. Sci., Proc. 12. pp. 675–677, Dec., 1926.)—In view of data reported by Lang, the lines previously assigned to V V [see Abstract 2866 (1926)] have been checked and confirmed. The corresponding doublets of Cr VI and Mn VII have been located and measured. Tables are given showing the confirmation of the regular and irregular doublet laws as applied to stripped atoms of the first seven elements of this period. F. S.

1422. *Sources of Error in Quantitative Chemical Analysis by Means of X-Ray Emission Spectra.* **H. Stintzing.** (Phys. Zeits. 27. pp. 844–853, Dec. 15, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—A historical review and a discussion of the fundamental errors and of the lines to be followed in the development of the method and apparatus. T. H. P.

1423. *Measurements on the Productivity of Röntgen Fluorescence.* **M. I. Harms.** (Ann. d. Physik, 82. 1. pp. 87–112, Dec. 16, 1926.)—The relation between the ionisation produced by the primary and the excited fluorescent rays is investigated. The transformation coefficient for Mo is evaluated as $u\alpha = 0{\cdot}69$. It is assumed that $u\alpha$ suffers no abrupt change in the series of elements. Curves based on the results showing the ionisation per unit energy in relation to wave-length are related to the $u\alpha$ of the element used. A difference in air and carbon dioxide which could be put down to argon could not be found. J. E.

1424. *Reflecting Power of the Carbon Atom for High-Frequency Rays.* **M. Ponte.** (Phil. Mag. 3. pp. 195–209, Jan., 1927.)—Diamond powder has been investigated by the ionisation chamber. The structure factor $1/\sqrt{2}$ has been found for the amplitude, and a law of variation with θ is given for the reflecting power which is the same for several wave-lengths (KαMo, KαCu, KβFe, KαFe). Results on rock-salt agree closely with Bragg and James [see Abstract 2413 (1922)], and a comparison with the results on the diamond gives $f_{C(111)} = 2 \cdot 7_5$ to about 10 %. The same method applied to naphthalene and anthracene (W. H. Bragg's models) gives $F_N = 16 \cdot 5$ and $F_A = 20 \cdot 2$ for the reflecting powers of these molecules, leading to $f_C = 5 \cdot 7$ and $5 \cdot 9$. Graphite gave $f_C = 3 \cdot 4$ (cleavage planes). It is concluded that the most important feature of the results is the impossibility of getting agreement with the observed $f(\theta)$ curves with four identical L electrons. One circular and three elliptical orbits are indicated. J. E.

1425. *J Phenomenon. Part V.* **C. G. Barkla** and **Gladys I. Mackenzie.** (Phil. Mag. 2. pp. 1116–1121, Nov., 1926.)—Continuing the work of the previous paper [see Abstract 386 (1927)], for which the X-ray tube was excited by an induction coil with a mercury jet interrupter, it is here found that the cause of the variable result there recorded depended on details of the process of excitation of the X-rays, such as the frequency of the interrupter. [See following Abstract.] W. H. Ge.

1426. *J Phenomenon. Part VI.* **C. G. Barkla** and **W. H. Watson.** (Phil. Mag. 2. pp. 1122–1127, Nov., 1926.)—A rotary converter with transformer has been used to supply the high potential, the control of the J discontinuities and associated phenomena has been obtained, and further discontinuities have been found. The critical absorbabilities, as usually measured, have been found to vary systematically with the current through the Coolidge tube. In these controlled experiments no difference has been observed between the absorptions of the primary and scattered radiations, except by the occurrence of the J discontinuities (or absorption lines) in the progressive absorption of the scattered radiation. [See preceding Abstract.] W. H. Ge.

1427. *Absorption of X-Rays from the Classical Standpoint.* **W. Bothe.** (Zeits. f. Physik, 40. 9. pp. 653–660, 1927.)—From the idea of an equivalent oscillator an empirical formula of Jauncey [Abstract 1811 (1924)] is deduced theoretically, including the numerical coefficient. It is also shown that the absorption edge can show no real discontinuity in the absorption coefficient and that the scattering coefficient rises suddenly on the long-wave side. J. E.

1428. *Absorption in the Region of Soft X-Rays.* **Elizabeth R. Laird.** (Phys. Rev. 29. pp. 41–49, Jan., 1927.)—Soft X-rays from the target were allowed to fall on a solid solution consisting of $CaSO_4 + 2\ \%\ MnSO_4$. The square of the time of duration of the thermoluminescence produced was assumed to be proportional to the total energy of the X-ray. The results indicate that in the range 40–610 volts the total energy varies approximately as the square of the potential applied to the tube. By interposing a thin celluloid film, about 25 $m\mu$ thick, between the target and the thermoluminescent substance, the transmission of the film was measured for various values of the applied potential from 40 to 610 volts. The transmission varied from 0·0 % at 40 volts (minimum wave-length 310 Å.) to 57 % at 610 volts (minimum wave-length 20 Å.). The results are in general agreement with the hypothesis that the absorption varies as the cube of the wave-length, that K absorption discontinuities in celluloid occur between 300 and 600 volts, and that the X-rays cover a wide spectral region. A photographic method of investigating absorption is also described. The results are fairly consistent with those obtained otherwise, but the method suffers from the fact that the photographic plate is not equally sensitive to energy of different wave-lengths. Computation based on previous measurements give for air values $\mu/\rho = 6 \cdot 0$, $6 \cdot 25$, $7 \cdot 0$, $7 \cdot 6 \times 10^3$ at 600, 500, 400, and 300 volts respectively. These figures agree fairly well with those given by Holweck in O_2 and N_2. For H_2 the value of μ/ρ is calculated to be about $1 \cdot 8 \times 10^4$, which is larger than the value given by Holweck and larger than is to be expected from the results for air. AUTHOR.

1429. *Satellites of Röntgen Diagram Lines.* **D. Coster** and **M. J. Druyvesteyn.** (Zeits. f. Physik, 40. 10. pp. 765–774, 1927.)—In the L series of the denser elements, and also for some of the other elements, very weak lines are found which cannot be placed in the ordinary scheme for these elements. The authors divide these satellites into two groups depending upon their occurrence on the hard or soft side of the diagram lines. They are investigated with a new form of Röntgen tube, and examined after fluorescent scattering. For the lines on the hard side the iron $K\alpha_3$ and $K\alpha_4$ lines were tested, and these satellites were found to be much less intense with fluorescent than with kathode-ray scattering. Their appearance indicates that in fluorescent scattering absorption processes occur at which two electrons are expelled simultaneously from the interior of the atom. Various possibilities for this process are discussed. For satellites on the soft side the lines under fluorescent scattering appear with normal intensity, the $L\beta_{14}$ line of Dy and the $K\beta'$ line of Fe being employed. It is considered that these satellites are indicative of the presence of an incomplete electronic ring in the atom, and reasons are given for this view. R. S. R.

1430. *A Vacuum Grating Spectrograph with Tangential Incidence for the Millikan Ultra-Violet and for X-Rays.* **J. Thibaud.** (J. de Physique et le Radium, 8. pp. 13–24, Jan., 1927.)—Gives the theory of the use of a plane grating with almost tangential incidence, which gives considerably increased dispersion, and makes it possible to obtain direct diffraction of X-rays, and an absolute measurement of their wave-length from the sharp line spectra obtained. The spectrograph is evacuated by means of a molecular pump, and contains a source for the extreme Millikan ultraviolet investigations, consisting of a condensed spark. It also contains two collimating slits and a support for the glass grating with 200 lines per mm., which is adjustable by means of set screws; there are no lenses; an ordinary photographic plate sensitised with a film of fluorescent oil is enclosed in the vacuum space: as an alternative a Rowland grating with a Schumann plate can be employed. It is found that, for wavelengths less than 500 Å., glass has a higher reflecting power than speculum metal. The spectra of C, Mg, Al, Fe, Cu, and Pt have been obtained, the whole spectrum from 6000 to 140 Å. being recorded on the same plate. The spectrum of Cu, which has been specially studied, is more dispersed than that of Millikan, and shows some new lines in the extreme ultraviolet. H. N. A.

1431. *Intensities in L-Röntgen [Spectral] Series.* **A. Jönsson.** (Zeits. f. Physik, 41. 2–3. pp. 221–229, 1927.)—Relative intensities of the $L\beta_1$, $L\beta_2$ and $L\gamma_1$ lines in the Röntgen spectra of Mo(42), Rh(45), Pd(46), Ag(47), Cd(48), In(49), Sn(50) and Sb(51) are determined. The results indicate that the intensities of the β_1 and γ_1 lines of the palladium group of elements, Mo, Rh, Pd, increase approximately linearly with the ordinal number. A sudden discontinuity occurs at the element silver, the intensities increasing suddenly thereat, and then increasing only slowly with increase of ordinal number. The results are in agreement with the Smith-Stoner theory of atomic structures. [See also Abstract 1588 (1926).] J. S. G. T.

RADIOACTIVITY.

1432. *Variation in the Range of α-Rays in Air.* **Irène Curie.** (J. de Physique et le Radium, 8. pp. 25–28, Jan., 1927.)—Considers the various experiments which have been made to determine the differences in range between α-rays with the same initial velocity in a given medium, including those made by the authoress, using the Wilson cloud method on the α-rays of polonium, and in collaboration with P. Mercier on those of RaC′ and RaA. It is shown that the scintillation method is not suitable for this purpose, since towards the end of the range an increasing proportion of the α-particles cease to produce scintillations. The maximum in Bragg's curve at about 5 mm. from the end of the α-ray range can only be attributed to the existence of a maximum in the variation of the ionisation along the path of each α-ray. The observations by the cloud method verify the theory, which is based on essential ideas relating to the structure of the atom and the fundamental laws of thermodynamics. H. N. A.

1433. *The Calorific Effect of β- and γ-Rays from Radiothorium.* **D. K. Yovanovitch** and **(Miss) A. Dorabialska.** (Comptes Rendus, 183. pp. 1037–1038, Nov. 29, 1926.)—Uses the calorimetric method of determining the coefficient of absorption of the β and γ-rays previously employed for radium [see Abstract 2632 (1926)]. The specimen tested was found to give 58 calories per hour due to α-rays, 8·2 due to β-rays, and the γ-radiation was equivalent to that from 28·95 mg. of radium. The mean coefficient of absorption of the β-rays in aluminium was found to be $\mu/\rho = 38 \cdot 3$. H. N. A.

1434. *High-Frequency Rays of Cosmic Origin. Part III. Measurements in Snow-Fed Lakes at High Altitudes.* **R. A. Millikan** and **G. H. Cameron.** (Phys. Rev. 28. pp. 851–868, Nov., 1926.)—The results of this investigation are summarised in the following sections: (1) "Absorption Experiments in Muir Lake (altitude, 11,800 ft.)." The sinking of a sealed electroscope on this snow-fed lake showed an ionisation decreasing steadily with depth from 13·3 ions per c.c. per sec. at the surface to 3·6 ions at 50 ft. below the surface, below which there was no further decrease.

(2) "Absorption Experiments in Arrowhead Lake (altitude, 5100 ft.)." The electroscope readings in this lake correspond uniformly to readings 6 ft. deeper in Muir Lake. This difference is the exact water equivalent of the absorption of the atmosphere between the two elevations. (3) "Rays of Cosmic Origin." The results of (1) and (2) combined with the failure to detect any systematic diurnal variation constitute unambiguous evidence for the existence of very hard etherial rays of cosmic origin entering the earth from all directions uniformly. (4) "Spectral Distribution of Cosmic Rays." The upper end of the absorption curve gives a coefficient 0·30 per metre of water, whilst the lower end gives 0·18 per metre of water. These coefficients correspond, by Compton's equations, to wavelengths $\lambda = 0{\cdot}00038$ Å. and $\lambda = 0{\cdot}00063$ Å. These are fifty times the frequencies of ordinary γ-rays, $\lambda = 0{\cdot}025$ Å., and the former corresponds to an energy of $32 + 10^6$ volts. (5) "Number of Pairs of Ions due to Cosmic Origin." About 1·4 at sea-level, 2·6 at 1600 metres, 4·8 at 3600 metres, and 5·9 at 4300 metres. (6) "Stimulated Secondary Rays." Evidence, which is considered uncertain, indicates in accordance with theory that the hard cosmic rays produce secondary β-rays which are capable of penetrating brass walls 5 mm. thick. (7) "Origin of Cosmic Rays." Evidence is presented that these rays do not result from the union of protons with negative electrons, but they are rather due to nuclear changes of about 1/30 of the energy corresponding to such union taking place throughout the depths of the universe. [For Parts I and II see Abstracts 2127 and 2128 (1926).] A. B. W.

1435. *Properties of High-Frequency Radiations.* **J. A. Gray.** (Nature, 118. pp. 801–802, Dec. 4, 1926.)—A formula of Dirac's [see Abstract 2542 (1926)] has been found to fit certain results of the writer's and H. M. Cave on γ-rays. That scattering decreases the effective penetration of γ-rays is shown by an experiment which also gives absorption coefficients not very different for brass, lead and water. Assuming Dirac's formula, μ/ρ for air and $\lambda = 0{\cdot}0004$ Å.U. will be equal to 0·00236, and if such rays enter the atmosphere, μ'/ρ (the apparent absorption) will increase, but at any depth below water will absorb as much as lead. Millikan's view that cosmic radiation of this wave-length is the primary cause of the ionisation observed in closed vessels is criticised on the ground that the large value of μ'/ρ found for lead on Pike's Peak is not to be expected, and cannot be accounted for by (1) more absorbable scattered rays from the air and earth below the electroscope; (2) more absorbable X-rays produced by secondary β-rays; and (3) secondary β-rays themselves. Thus no conclusive evidence exists for Millikan's view of cosmic radiation. J. E.

1436. *Scattering of γ-Rays.* **L. H. Clark.** (Nature, 119. pp. 121–122, Jan. 22, 1927.)—Gray (see preceding Abstract) has pointed out that the study of waves shorter than 0·02 Å. is complicated by scattered radiations accompanying them. The writer has shown that γ-rays produce softer scattered rays [Abstract 2619 (1926)]. This letter is an account of confirmatory experiments. J. E.

1437. *Mass Determination of Atomic Particles.* **G. Stetter.** (Phys. Zeits. 27. pp. 735–738, Nov. 15, 1926. Paper read before the Deut. Narturforscher u. Ärzte, Düsseldorf, 1926.)—The author describes briefly what he calls a mass spectrometer (after Aston) for "atomic fragments," *i.e.*, for the products of the bombardment of atoms by α-particles of high velocity. With this apparatus the author obtains a much larger number of scattered α-particles and H-particles than was possible with the earlier forms, and it is now a comparatively simple matter to obtain *e/m* by the magnetic deflection of the various groups of particles (scattered α-particles, H-particles, and disintegrated atomic nuclei, etc.). Curves are given showing the applications of the method and indicating the relative number of the various scattered and disintegrated particles. [See also Abstracts 314 (1926) and 156 (1927).] A. B. W.

1438. *Determinations of Absorption and Range for " Natural " H-Rays.* **Elisabeth Rona.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 3–4. pp. 117–126, 1926.)—It is shown that polonium is much more suitable than RaC for producing H-rays for purposes of measurement, as difficulties with β- and γ-rays are avoided. New measuring instruments are described, including one in which compressed air is used for determining the range and for measuring the absorption. It was found that the values of the air equivalents of mica, copper, silver and gold are the same as in the case of α-rays. The range of the H-rays in air was found to be between 16·1 and 16·4 cm., in good agreement with theory. H. N. A.

1439. *Radioactivity of Potassium and its Geological Significance.* **A. Holmes and R. W. Lawson.** (Phil. Mag. 2. pp. 1218–1233, Dec., 1926.)—The paper is divided into the following sections: (1) The problem of the pre-Cambrian granites. (2) The radioactive constants of Rb and K. (3) The emission of energy by Rb and K. (4) Possible effects other than thermal. (5) The average thickness of the continents. (6) The nature of the substratum. (7) Geological time and latent heat. (8) Conclusions —*viz.*, (*a*) The velocities of the β-rays emitted by Rb and K are respectively 0·60c. and 0·85c. The corresponding kinetic energies are $2{\cdot}04 \times 10^{-7}$ and $7{\cdot}30 \times 10^{-7}$ erg. (*b*) On available data, the most probable half-value period of Rb is $T_{Rb} = 10^{11}$ years, and of potassium $T_K = 1{\cdot}5 \times 10^{12}$ years. The disintegration constants are $\lambda_{Rb} = 6{\cdot}9 \times 10^{-12}$ year^{-1} for Rb and $\lambda_K = 4{\cdot}6 \times 10^{-13}$ year^{-1} for K. (*c*) As an emitter of radiothermal energy in rocks potassium is, in the aggregate, of the same order of importance as uranium or thorium. A. B. W.

1440. *The Existence and Half-Period of Radium C′.* **A. W. Barton.** (Phil. Mag. 2. pp. 1273–1282, Dec., 1926.)—The author has repeated the experiment of Jacobsen for investigating the existence of RaC′ and obtaining a rough value of its half-period, using the β-ray recoil method to separate the RaC′ from RaC. He has endeavoured as far as possible to eliminate certain difficulties due to scattering of the beam of recoiling RaC′ atoms and to the uncertainty of the method of eliminating the effect of " contamination," since the increase of pressure used by Jacobsen to do this might alter the contamination and possibly other spurious effects; he points out that an efficiency of recoil of 2 % would be required to obtain Jacobsen's results. The velocity of the recoil atoms was assumed to be 4×10^5 cm. per sec., and reasons are given for this. Jacobsen used the maximum theoretical value 8×10^5 cm. per sec., but it is quite certain that only a small fraction of the recoil atoms would have this velocity. The results confirm Jacobsen's experiments, the existence of RaC′ and the half-period of the order of 10^{-6} sec. H. N. A.

HEAT.

1441. *Heat Conduction in a Medium in which the Source of Heat is Everywhere Uniformly Distributed.* **Y. Ikeda.** (Hokkaido Imp. Univ. Faculty of Eng. Mem. 1. 2. pp. 91–103, Dec., 1926.)—This is a mathematical paper dealing with conduction of heat in a body when the heat source is distributed in a uniform manner. The integrals of the general differential equation are obtained, and the results applied to the problem of the cooling of fresh concrete in very cold weather. T. B.

1442. *An X-Ray Method for Determining the Coefficient of Thermal Expansion at High Temperatures.* **K. Becker.** (Zeits. f. Physik, 40. 1–2. pp. 37–41, 1926.)—Measurements are made by the Debye-Scherrer method in a special camera with water cooling; the substance to be measured can be heated by passing a current through it if it is a conductor, otherwise by means of an electrically heated tungsten spiral. To prevent oxidation a stream of hydrogen or nitrogen can be passed through the interior of the camera. The measurements of the lines on X-ray photographs taken at different temperatures make it possible to determine the coefficients of expansion. Tables are given showing the values obtained, using the lines reflected from a number of crystal surfaces, for tungsten, silicon, carborundum, zirconium oxide and a rod of the material used in a Nernst lamp. H. N. A.

1443. *A Method of Comparing the Thermal Conductivities of Metal Rods.* **G. W. Todd.** (Journ. Sci. Instruments, 4. pp. 97–99, Jan., 1927.)—The two metal rods of diameters d_1 and d_2 and coefficients of expansion α_1 and α_2 are mounted parallel to each other with one end of each rigidly fixed. The fixed ends are heated to the same temperature by hot water or steam, the remainder of the rod being exposed to atmospheric temperature, and allowed to expand. The total expansions E_1 and E_2 are measured with the help of a magnifying device, the coefficients of expansion α_1 and α_2 being known. The rods are coated with a thin film of heat-resisting black paint, so that their emissivities are the same. The ratio of their thermal conductivities K_1/K_2 is then obtained from the equation $K_1/K_2 = d_2(E_1\alpha_2)^2/d_1(E_2\alpha_1)^2$. Temperatures must be kept constant, but there is no need to measure them accurately. The lengths of the rods must be great enough to ensure that some parts of their cooler ends are at the temperature of the surrounding medium. A few results are given in comparison with a standard copper rod. T. B.

1444. *Temperature Distribution Along a Filament.* **V. Bush** and **K. E. Gould.** (Phys. Rev. 29. pp. 337–345, Feb., 1927.)—A method has been developed for adapting a new integrating machine to the solution of (1) the integral equation which applies to the distribution of thermionic emission along the central portion of a long filament in an evacuated vessel, the effect of the thermionic emission upon the filament temperature (by changing the heating current as well as by a direct cooling action) being considered; (2) the differential equation which applies to the temperature distribution near the end of a long filament from which the thermionic emission is negligible compared with the filament heating current; (3) the integro-differential equation which applies to the distribution of temperature and thermionic emission along an entire filament heated, in an evacuated vessel, by a direct current. This takes into account the effects of thermionic emission as well as cooling due to thermal conduction. All these solutions fully account for the variation of the following quantities with temperature, graphical relations being used throughout: (*a*) thermal conductivity; (*b*) thermionic emission; (*c*) resistivity; (*d*) radiation. The method has been applied to various typical cases of tungsten and thoriated tungsten filaments, and in those cases where an experimental check was possible it was found that the results were in good agreement with the measured quantities. AUTHORS.

1445. *The Specific Heat of a Sufficiently Cooled Non-Condensed Phase.* **N. Perrakis.** (Comptes Rendus, 184. pp. 28–30, Jan. 4, 1927.)—It is known that the specific heat of a condensed phase diminishes much more rapidly than the temperature itself. At some interval (T_a, T_b) the specific heat of solids or liquids will become zero. The non-condensed phase at the limit T_a will, however, not lose its characteristic properties. The question arises as to what is the specific heat of a gas in the interval T_a–T_b. Eucken has shown that the molecular heat of hydrogen at very low temperatures is in the neighbourhood of 3 calories, and Perrin has extended this result generally. The author has now arrived at the same conclusion from simple thermodynamic considerations, and concludes that "every gas sufficiently cooled takes the molecular heat of a monatomic gas." T. B.

1446. *Specific Heat of Gaseous Nitrogen Tetroxide.* **E. D. McCollum.** (Am. Chem. Soc., J. 49. pp. 28–38, Jan., 1927.)—A specially designed flow calorimeter is employed, which is suitable for the measurement of the specific heats of gases over small temperature intervals. The gas is cooled before entering the calorimeter, and the cooling effect is counterbalanced by electrical heating. The apparent heat capacity of gaseous N_2O_4 is measured over small temperature intervals from 33° to 98° C. The values obtained are high as a result of dissociation. A maximum value is found at 62° C. The true heat capacity is determined by subtraction of the heat absorbed by dissociation from the apparent heat capacity. A. B. C. L.

1447. *Immiscibility in Silica Melts.* **J. W. Greig.** (Am. J. Sci. 13. pp. 1–44, Jan., 1927.)—The furnace employed is of the cascade type, with an inner winding of 60 Pt 40 Rh and an outer winding of platinum. The platinum in both cases was carefully purified to avoid contamination of the thermoelement and alteration of the e.m.f. produced by it. The melting point of cristobalite was determined by means of a series of quenches of material prepared from purified quartz, and from two quartz crystals in their natural state, which showed no inclusions under the microscope. The melting point was fixed at 1713° ± 5° C.; this agrees with Ferguson and Merwin's value 1710 ± 10° C. The formation of liquid below the melting point is ascribed to the presence of minute quantities of impurity. Binary systems of SiO_2 with MgO, CaO, and SrO were studied by the quenching method; it was found that two different liquids were present in the melt, forming mixtures of two different glasses when quenched; the temperatures at which cristobalite is in equilibrium with these two liquids were determined, and the results are illustrated by equilibrium diagrams of the different systems and by reproductions of microphotographs. With the system BaO–SiO_2 only one glass was formed, so that there is no immiscibility, and the same is true of Al_2O_3–SiO_2, Na_2O . SiO_2–Si_2O and K_2O . SiO_2–SiO_2. Immiscibility was also studied in a number of ternary systems, such as MgO–Al_2O_3–SiO_2, and equilibrium diagrams are given for them. H. N. A.

1448. *Methods and Apparatus Used in the Cryogenic Laboratory. The Methyl-Chloride and Ethylene Circulations. The Hydrogen Liquefier and Circulation. The Helium Liquefier and Circulation.* **H. K. Onnes.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1174–1183, 1926.)—Descriptions and illustrations are given of more recent additions and improvements in cryogenic apparatus referred to in the title, as employed in the Physical Laboratory at Leyden. A. B. C. L.

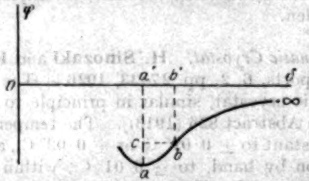
1449. *An Automatic Cryostat.* **H. Sinozaki** and **R. Hara.** (Tôhoku Univ., Technol. Reports, 6. 2. pp. 27–33, 1926.)—The paper is a description of an automatic cryostat, similar in principle to the hand-regulated one of Henning [see Abstract 826 (1913)]. The temperature is automatically maintained constant to ± 0·02° C. or ± 0·03° C., and, with additional occasional regulation by hand, to ± 0·01° C., within the range 0° C. to 150° C. About 3 litres of liquid air are consumed in order to cool down the cryostat of 1400 c.c. capacity to − 100° C. and to maintain it at this temperature for nearly thirty hours. E. G.

1450. *Melting Curve of Hydrogen.* **H. K. Onnes** and **W. van Gulik.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1184–1187, 1926.)—Using a method based upon that usually employed for the determination of the viscosity of liquids and gases by streaming in a narrow tube, the melting curve of H is determined for pressures up to 55 kg./cm.^{2}. The values obtained lie almost on a straight line, from the extrapolation of which is obtained for the melting pressure corresponding with the critical temperature liquid-gas a value of 600 kg./cm.^{2}. A. B. C. L.

1451. *Fusion Curve of Helium.* **G. Tammann.** (Ann. d. Physik, 82. 2. pp. 240–242, Jan. 12, 1927.)—Recently Keesom [see Abstract 2647 (1926)] has published the coordinates of the fusion and vapour pressure curves of helium between 1·13° and 4·21°, and shown that these do not intersect so that no triple point exists at which vapour, liquid and crystalline helium are in equilibrium. The present author now discusses the fusion curve and finds the entropy difference, R_p/T, not to be zero at $T = 0$, but to have a very small value, *viz.*, in $R_p/T = 0{\cdot}23\ \Delta v$ cm./kg. H. H. Ho.

1452. *Correction for Heat Exchanges between a Calorimeter and its Surroundings.* **P. E. Klopsteg.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 589–595, Nov., 1926.)—A description is given of a method by which the temperature-rise in calorimetric experiments can be found, yielding results which are as accurate as ordinary calorimetric data can be expected to give. This is accomplished by determining graphically the rate of temperature change in the calorimeter resulting from heat exchanges with the surroundings. The method is an application of well-known principles in calorimetry. In a test of the method results are shown for a series of determinations of the mechanical equivalent of heat for which the average value is 426·1 gm./cal. as against 419·6 when another method of correction was used with the same data, and 435·7 when the temperature-rise was not corrected. E. G.

1453. *Theory of the Heat of Melting.* **N. v. Raschevsky.** (Zeits. f. Physik, 40. 3–4. pp. 214–219, 1926.)—While the heat of sublimation has a definite atomic meaning, namely, the work necessary to move a given number of atoms from their stable position in the crystal to an infinite distance apart, there is no analogous meaning to the heat of liquefaction. If we consider the connection between the potential energy of a number of atoms ϕ and their distance apart δ, we get a curve as shown, in which



oa' represents lattice constant of the solid and *aa'* the heat of sublimation. At *b* we have $\frac{d^2\phi}{d\delta^2} = 0$, and the solid passes to liquid state as δ passes through the value *ob'*, hence *ac* denotes the heat of melting. An expression for ϕ is developed, and using the condition $\frac{d^2\phi}{d\delta^2} = 0$, an expression is obtained which is equivalent to stating that in the liquid state the modulus of elasticity = 0, from which, by making use of Grüneisen's values for the index of the repulsion law between the atoms, the heats of liquefaction are calculated for seven metals and found to agree well with the experimental values. T. B.

1454. *Heats of Combustion of Proposed Secondary Standard Substances.* **L. J. P. Keffler** and **F. C. Guthrie.** (J. Phys. Chem. 31. pp. 58–68, Jan., 1927.)—A description is given of a design of adiabatic calorimeter of the Berthelot-Mahler type which is provided with means of raising the temperature of the water in the outer enclosure to correspond to that of the inner vessel during the combustion. The procedure is arranged so that the same initial and final temperatures of the calorimetric water are obtained and the readings are thus relatively independent of errors in the scale of the Beckmann thermometer used. The results obtained for the heats of combustion of naphthalene and salicylic acid show by their concordance that both are very suitable as secondary standards for bomb calorimetry, although salicylic acid is perhaps slightly better owing to its lower volatility. The consideration of the heats of combustion of the ortho- meta- and para-hydroxy derivatives of benzoic acid leads to the conclusion that the energy contents of the ortho and meta derivatives are the same within the limits of experimental error, whilst a very slight difference, of the order of about three times the experimental error, is indicated in the case of the para compound as compared to the ortho- and meta-isomers. The values obtained for the two optically active forms of borneol show that there is no energy change involved in the transformation of the one form into the other. J. N. P.

1455. *Sublimation Pressures of Substituted Quinones and Hydroquinones.* **A. S.** and **Margaret S. Coolidge.** (Am. Chem. Soc., J. 49. pp. 100–104, Jan., 1927.)—The sublimation pressures of a series of substituted quinones and hydroquinones were determined at 25° C. by means of the quartz fibre manometer [see Abstract 1345 (1924)], the logarithms of the pressure being plotted against the reciprocal of the temperature at various temperatures, the value at 25° C. being then determined by extrapolation. From the slopes of the straight lines thus obtained, the heats of sublimation were calculated, the value for hydroquinone being 24,000 calories per mol., which is in good agreement with the accepted figure. B. W. C.

1456. *Gas Degeneration and Paramagnetism.* **W. Pauli, Jr.** (Zeits. f. Physik, 41. 2–3. pp. 81–102, 1927.)—The paper commences with a review of the present position of the gas degeneration problem, and especially of the discussion of Einstein's theory [see Abstract 1439 (1925)]. Fermi's quantum statistics of the perfect monatomic gas, which depend on a generalisation of the equivalence rule of atomic structure, are extended to the case of gas atoms with impulse of rotation and then applied to the magnetisation of such gases. If the conducting electrons in metals be regarded as constituting a perfectly degenerate gas—an assumption which is only provisional for the special objects of the investigation—then a theoretical viewpoint of the facts is derivable, which is at least qualitative. The results indicate that, in spite of the presence of the special moments of the electrons, many metals (particularly the alkali metals) exhibit in the solid state no paramagnetism or at least only a very feeble and approximately temperature-independent effect. The paper is entirely mathematical. H. H. Ho.

1457. *Concentration of Water Vapour in Compressed Gases.* **E. P. Bartlett.** (Am. Chem. Soc., J. 49. pp. 65–78, Jan., 1927.)—Hydrogen, nitrogen and a 3·1 mixture were studied. The gas was bubbled through water at constant temperature and pressure, then expanded through a needle valve and dehydrated by phosphorus pentoxide. The volume of expanded gas was measured and also the gain in weight of the pentoxide. In the case of nitrogen at 50° and 100 atmos., the increase in water content was found to be 4-fold that computed by the usual method, or twofold if allowance for deviation from a perfect gas be made. A litre of nitrogen will hold 44 % more water vapour than a litre of hydrogen under the same conditions. Quantitative relationships have not yet been detected between observed and calculated results. F. S.

1458. *The "Uniform Movement" of Flame in Mixtures of Hydrogen and Air.* **Elizabeth H. M. Georgeson** and **F. J. Hartwell.** (Chem. Soc., J. pp. 265–267, Jan., 1927.)—Typical photographs are reproduced of flames passing in different mixtures of hydrogen and oxygen. Tubes of transparent quartz are employed and the flames are photographed through a quartz lens on paper of high sensitivity mounted on a rapidly revolving drum. The conditions for uniform and for vibratory movement are ascertained. J. N. P.

1459. *Movement of Flame in Closed Vessels: Correlation with Development of Pressure.* **O. C. de C. Ellis** and **R. V. Wheeler.** (Chem. Soc., J. pp. 153–158, Jan., 1927.)—The propagation of flame in explosive mixtures of carbon monoxide and air is investigated in an explosion vessel of phosphor-bronze, the interior of which can be rendered spherical or cubical at will, fitted with windows through which the flame can be photographed and with a pressure gauge of the diaphragm type. Ignition is effected electrically at the centre of the vessel. By means of a revolving drum a record is obtained of the movement of the flame in a horizontal plane in both directions from the spark. It is seen from these results that with all mixtures except those in which the flame-front travelled very slowly (mixtures containing less than about 25 % or more than about 65 % of carbon monoxide) the moment of maximum pressure coincides, within less than half a millisecond, with the arrival of the flame-front at the boundary of the vessel. With the cubical cavity the provision of two revolving drums enables simultaneous photographs to be taken of the flame-front as it moves from the centre of the cube (*a*) towards the walls, and (*b*) towards the corners. The extent to which cooling occurs during the development of pressure when part of the flame-front can touch a cold metal surface whilst the remainder is still travelling through part of the mixture is illustrated. It is also seen that the character of the " cooling curve " is affected by the shape of the explosion vessel. J. N. P.

1460. *Flame Spectrography in an Internal-Combustion Engine.* **A. Henne** and **G. L. Clark.** (Comptes Rendus, 184. pp. 26–28, Jan. 24, 1927.)—The authors have investigated the relation between the length of the ultra-violet part of the spectrum and the phenomenon of " knocking." They employed a Delco monocylinder, mounted directly on the shaft of a dynamo, the temperature of the cylinder being controlled by a variable current of air, and measured by a thermocouple. A Midgeley and Boyd indicator was used. Photographs of each of the four cycles were taken separately, an " obturator " being employed in such a way that any particular small part of the cycle could be observed and photographed for several hours through a quartz window in the wall of the cylinder. In the case of normal working of the engine the spectrum extends from the visible end to about **3400 Å.**, and is of equal length in the four cycles. When " knocking " is produced the spectrum is lengthened to about **2360 Å.** in the first cycle, and is very intense in character; the second is less intense and shorter; and the third and fourth similar to those in the normal working of the engine. When an anti-detonant, such as tetra-ethyl-lead, is employed, the spectrum is the same as when the engine is working normally. Metallic lines of lead appear in the spectrum, but only during the first part of the cycle. T. B.

1461. *Photographic Measurement of the Rate of Detonation of Explosives.* **G. S. J. Perrott** and **D. B. Gawthrop.** (Frank. Inst., J. 203. pp. 103–110, Jan., 1927.)—The rate of detonation of an explosive furnishes a guide to determine the purpose for which it is best suited. Various methods for obtaining the rate of detonation are in use, *e.g.*, the Mettegang, Dautriche, condenser discharge, and a method described by Smith [Abstract 2131 (1925)] that employs spark photography of sound waves produced by the detonation. The photographic method described in the present paper gives a permanent record which shows the rate of detonation at every point in the file of explosive. A drum rotating with a peripheral velocity of 20 metres per sec. carries a sensitised film on which an image of the flame of detonation is focussed by means of a quartz lens. The charge, 30 to 70 in. long, is detonated from the bottom by means of a No. 6 electric detonator, and the rate of detonation is indicated by the tangent of the angle which the sharp edge of the image of the flame makes with the horizontal. Determinations are made on the rate of detonation of dynamite, ammonium-nitrate-nitroglycerine, and other explosives. Typical photographs are given. T. B.

1462. *The Effect of Water on the Infra-Red Emission from the Flame and Explosion of Carbon Monoxide and Oxygen.* **W. E. Garner** and **C. H. Johnson.** (Phil. Mag. 3. pp. 97–110, Jan., 1927.)—Using a Hilger pattern spectrometer, with rock-salt prism and Rubens-Coblentz thermopile, the infra-red spectrum of CO burning in O has been studied for the flame and for explosions. It was found that small quantities of water vapour decreased the emission of infra-red radiation from the explosion to a remarkable extent, this being accompanied by a corresponding increase in the rate of reaction. This is a special case of a general phenomenon for which the name *energo-thermic catalysis* is proposed, the action of water is regarded as positive, while substances like carbon tetrachloride and nitrogen peroxide, which diminish the rate of temperature-rise and retard the speed of explosion, are spoken of as negative catalysts. The theory proposed supposes that the chemical union of 2CO and O_2 gives two molecules of $2CO_2$ with a certain amount of internal energy, this energy may be radiated away without heating the gas, the radiation lying in the infra-red at 2·8 and 4·4 μ (chemiluminescence). When water is present collisions take place between its molecules and the freshly formed CO_2 molecules, some of these lose their internal energy by collision, and it is converted into thermal energy, others may be reconverted into 2CO and O_2, and still others may radiate their internal energy. In any case, the total radiation is diminished and the temperature is increased.

H. N. A.

1463. *A Transformation of the Theoretical Chemical Constants.* **E. Wertheimer.** (Phys. Zeits. 27. pp. 771–774, Dec. 1, 1926.)—This is a mathematical deduction of the vapour-pressure equation

$$p = (1/\pi^{3/2})(RT/W_1)^{3/2}(e^{-\lambda_0/RT}/V_f) \,.\, RT$$

from a result previously given (Phys. Zeits. 22. pp. 186–191, 1921) by Herzfeld. The paper is not suitable for a brief abstract. T. B.

1464. *Vapour Pressure and Heat of Dilution of Aqueous Solutions. Part II.* **W. R. Harrison** and **E. P. Perman.** (Faraday Soc., Trans. 23. pp. 1–22, Jan., and Disc., 107, March, 1927.)—By means of an improved statical method described in an earlier publication [Abstract 161 (1924)] measurements are made of the vapour pressure of aqueous solutions of potassium chloride and calcium chloride at varying concentrations, and at a series of temperatures from 40° C. to 80° C. Density measurements of the solutions are made under the same conditions. With calcium chloride curves of vapour pressure plotted against concentration show a double flexure at the higher concentrations. The negative heats of dilution are

measured electrically as previously described [Abstract 1860 (1926)]. The differential heats of dilution and their variation with temperature are calculated by means of a modification of the Kirchhoff equation as put forward by Porter, and the values are found to agree with those measured experimentally. Calcium chloride has a large negative and potassium chloride a small positive heat of dilution which increases with temperature.
J. N. P.

1465. *Vapour Pressures of Mixtures of (a) Methyl Acetate and Water, and (b) Methyl Acetate, Sucrose and Water.* **A. McKeown** and **F. P. Stowell.** (Chem. Soc., J. pp. 97–103, Jan., 1927.)—The vapour pressures of the volatile constituents in ester-water and ester-sucrose-water mixtures were determined, with a view of testing the various "activity" theories of reaction velocity in the special case of hydrolysis of methyl acetate by acids. The vapour pressures were measured at temperatures of 25° and 30° C. The total vapour pressures were measured by a method different from that used for determining the partial pressures. The nature of the partial pressure curves suggests the formation of a compound between water and methyl acetate in aqueous solutions of the ester. F. J. B.

1466. *Vapour Pressure of Water over Sulphuric Acid-Water Mixtures at 25° C.* **I. R. McHaffie.** (Chem. Soc., J. pp. 112–116, Jan., 1927.)—Measurements of the vapour pressures of water over sulphuric acid-water mixtures, containing from 66 to 84 % of sulphuric acid, were made at 25° C. The method of measuring small amounts of water present in air was shown to be reliable for pressures as low as 0·08 mm. The results agree with the experimental values obtained by Brönsted and with those calculated by Wilson, but not with the data given in Landolt-Börnstein tables for 25° C. F. J. B.

1467. *Thermodynamic Consequences of the Conservation of Photons.* **G. N. Lewis.** (Nature, 118. pp. 874–875, Dec. 18, 1926.)—To the discrete particles which under certain circumstances become carriers of energy or quanta the name photons is given. It is assumed that photons in any system are conserved if that system is isolated. This hypothesis seems inconsistent with the Wien and Planck derivation of the displacement law, but it appears that in this derivation an assumption is made that is not actually supported by any observations. If instead the conservation of photons is assumed, a new and generalised thermodynamics can be developed. Spectroscopically there are difficulties. If an atom falls from one state to another directly, one photon is emitted, but if it passes through intermediate states, more than one photon must be emitted, and the relation between the initial and final states in the two cases cannot be identically the same. Thus any given state may be multiple, and it is suggested that recent unexplained fine structures may be due to this. It is hoped that experimental verification of the theory may be possible.
A. Wh.

1468. *Remarks on the Principles of Carnot and Clausius.* **C. Raveau.** (Comptes Rendus, 183. pp. 1337–1340, Dec. 27, 1926.)—The author deals with the necessary and sufficient conditions underlying Carnot's enunciations and the "Inequality" of Clausius. The connection between the two principles is discussed and is considered also geometrically. T. B.

SOUND.

1469. *Sound Waves and Silent Regions in the Atmosphere.* **H. Galbrun.** (Comptes Rendus, 183. pp. 1019–1020, Nov. 29, 1926.) A brief note dealing with certain phenomena of long-distance hearing. W. H. Ge.

1470. *A New Sound Measurer.* **H. Barkhausen.** (Zeits. techn. Physik, 7. 12. pp. 599–601, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—A hummer interrupter is connected to two dry cells and a rheostat, and a measured current is led from the hummer to a telephone. This forms in one ear a source of sounds the loudness of which may be adjusted to balance that of another sound heard by the other ear. The accuracy attainable by the method is about 25 %, and the measurement does not appear to be affected by the pitch or quality of the sound tested. The apparatus has been used to measure the variation of loudness with distance of the source, and in the open the expected variation with the inverse distance was obtained. The method has also been employed to test room-acoustics and also the variation of loudness with direction of the source, polar diagrams being constructed. The suggested unit of loudness is the Wien, a loudness of 100 Wien being such that the reduction of the current in the telephone to 1/100th just makes the standard sound inaudible. On this scale, loudness numbers would range from 1 to about 10,000; the term pianissimo would be represented by 4 and fortissimo by 1000. In terms of a logarithmic scale of "phons," these become 2 and 10 respectively. G. E. A.

1471. *Performance and Design of Sound Radiator Consisting of an Acoustic Transformer and Horn.* **K. Kobayashi.** (Inst. El. Eng. of Japan, J. No. 461. pp. 1437–1445, Dec., 1926.)—[See also Abstract 2923 (1926).]

1472. *Continuous Motion Produced by Vibration.* **W. B. Morton** and **A. McKinstry.** (Phys. Rev. 29. pp. 192–196, Jan., 1927.)—A special case of motion of this kind was discussed recently by A. T. Jones [see Abstract 2912 (1926)]. In the present note attention is called to a number of other cases in which the precise mechanism is obscure. A simple form of the phenomenon occurs when a mass is made to slip along a rough inclined plane, without loss of contact, by making the plane oscillate. This is examined mathematically. It is found that the motion may be either upwards or downwards, according to the relation between the direction of oscillation and the inclination of the plane. The results have been roughly verified by experiment. Authors.

1473. *Ponderomotor Effects of Sound on Air Resonators.* **G. Hippe.** (Ann. d. Physik, 82. 2. pp. 161–183, Jan. 12, 1927.)—Meyer's quantitative work [see Abstract 914 (1924)] on the forces acting on membrane resonators in a sound field is first briefly discussed, following which the present supplementary investigation is described which relates to air resonators with various mouthpieces. Hollow resonators with a single opening are quantitatively examined by means of a sensitive torsion balance.

It is found that strong reaction forces are developed which are dependent on the form of the mouth of the resonator. By the use of cylindrical mouthpieces it has been found possible to suppress essentially these reaction forces when the tone quality is found to be dependent on the forces in a similar way to that obtained by Meyer with membrane resonators. The absolute magnitude of these forces lies between 0·001 and 0·01 dynes with a maximum of 0·03, whereas the reaction forces are 10–30 times as high. An apparatus suitable for lecture demonstration purposes has been devised in which the acoustic reaction forces may be increased by a million-fold and powerful enough to set a weight of 3/4 kg. in rotation. The paper is replete with data and illustrations. H. H. Ho.

1474. *Vowel Sounds.* **I. B. Crandall.** (Bell System Techn. J. 6. pp. 100–116, Jan., 1927.)—Analyses of the frequency spectra of vowel sounds [see Abstract 2556 (1924)] show almost invariably two principal resonance peaks, and this suggests that they are produced by a double resonator. The double-resonator system is here treated mathematically, considering the effects of volume, shape and coupling of the resonating chambers and relating these to known factors in the case of the mouth and the pharynx. Experimental tests on vowel production with models made of cardboard and plasticene gave good results for the sound ā (as in father) and fair results with ō, ǎ and ĕ. The method of excitation has an important effect. G. A. S.

1475. *Transmission and Reflection of Sound by Partitions.* **A. H. Davis** and **T. S. Littler.** (Phil. Mag. 3. pp. 177–194, Jan., 1927.)—A uniform beam of sound is directed by means of a paraboloidal reflector to fall obliquely on a partition, and measurements are made in the reflected and transmitted beams (Watson's method). The partitions are 5 ft. by 4 ft., and could therefore vibrate as a whole, as happens in practice. No reaction on the electrodynamic loud speaker used as source is found when the partition is in place. The actual measuring arrangement used has the advantage that under the conditions normally present the results of the exploration are unaffected by variations in the current operating the source. Transmission and reflection ratios are found to be almost independent of the position in the beam at which measurements are made. Curves are given showing the transmission through one, two, three and four layers of felt for frequencies ranging from 250 to 1600 vibrations per sec. A comparison is made between these results and those of P. E. Sabine, who used a reverberation method. G. A. S.

1476. *Propagation of Sound in Bessel Horns.* **S. Ballantine.** (Frank. Inst., J. 203. pp. 85–102, Jan., 1927.)—Equations are developed for the propagation of wave motion in horns, the areas of whose circular sections perpendicular to the axis are of the general type given by $A = A_0 x^m$, where x is the distance along the axis of the horn. Computations are made of the throat resistances for different frequencies in the case of infinite horns for $m = 1, 2, 4$ and 7. The "exponential horn" ($m = 2$) has no special cryptic significance, as is frequently assumed. G. A. S.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

1477. *J. J. Thomson's Model of a Light-Quantum.* **N. P. Kasterin.** (Phil. Mag. 2. pp. 1208–1212, Dec., 1926.)—From preceding considerations it is concluded that Maxwell's equations actually lead to the solution given by J. J. Thomson, and it seems to the author that the difference between the Maxwell-Hertz-Lorentz electromagnetic theory and the theory of Faraday-Maxwell-J. J. Thomson might be *analytically* formulated as follows: (1) For the free æther the differential equations are the same in both theories, being the Maxwell's system :—

$$\operatorname{div} \mathbf{E} = 0 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\operatorname{curl} \mathbf{M} = \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\operatorname{div} \mathbf{M} = 0 \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\text{and} \qquad \operatorname{curl} \mathbf{E} = \frac{1}{c}\frac{\partial \mathbf{M}}{\partial t} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

(2) The first theory postulated that all these equations are valid in the *whole* space filled by the free æther; in the second theory the equation (3) occurs *only* where we have a moving electric field. Formulating this difference *geometrically*, we may say that the electric lines of force in the free æther are everywhere continuous, while the magnetic may be *discontinuous*: they must end on the boundaries dividing the moving Faraday tubes from those at rest. This circumstance gives the possibility of introducing *discontinuities* into the electromagnetic field, and enormously increases the variability of the special instances which satisfy the Maxwell systems of equations. The Maxwell equations, as has been shown above, admit such forms of electromagnetic fields as have the same properties as the light-quanta. It seems to the author that this interpretation enables us to construct, on the basis of Maxwell's equations, investigating them for the case $\beta_n^2 = 1$, a *rational* quantum theory. From the point of view of J. J. Thomson's theory the structure of the field is *discontinuous*. The field consists of a system of Faraday tubes moving relatively to one another; the intensity of the magnetic field is determined by the intensity of the electric field and by the normal velocity β_n of the tube from the equation $M = \beta_n E$. G. W. DE T.

1478. *Torque on Revolving Cylindrical Magnet.* **A. L. Kimball, Jr.** (Phys. Rev. 28. pp. 1302–1308, Dec., 1926.)—In a recent article Zeleny and Page [see Abstract 633 (1925)] have shown that the torque on a revolving cylindrical magnet, with a side arm dipping into a mercury trough, consisted of two parts, namely, a torque arising from a reaction between the current in the side arm and the external magnetic field, and a torque produced by the reaction between the current flowing in the magnet and the flux within the magnet. In this paper the torque is considered as arising from the reaction between the external circuit and the external field. From the viewpoint of the electrical engineer, this is the better way of looking at the problem because it involves the conception of a reaction between a magnetic field revolving the rotor and a fixed external circuit, which is in conformity with the usual method of analysis of rotating electrical machinery. A detailed analysis is given from this point of view which gives a value for the torque identical with that of Zeleny and Page. That there must be such an agreement can also be shown from general considerations, such as from the law of action and reaction, or from considerations of flux linkage. AUTHOR.

1479. *Electromagnetic Field.* **U. Crudell.** (Accad. Lincei, Atti, 4. pp. 522–523, Dec. 5, 1926.)—A mathematical note on the relations of the tangential component, electric or magnetic, to the radial component of a curved electromagnetic field. F. S.

1480. *Electromagnetic Theory and the Foundations of Electric Circuit Theory.* **J. R. Carson.** (Bell System Techn. J. 6. pp. 1–17, Jan., 1927.)—The familiar equations which are used to solve for the currents and charges in linear networks summarise the inductive analysis of countless observations made upon such networks. Having been arrived at by inductive methods, these familiar equations of Ohm, Faraday and Kirchhoff are substantially independent of the more general electromagnetic theory of Maxwell and Lorentz. The present paper examines the foundation of electric circuit theory from the standpoint of the fundamental equations of electromagnetic theory, and a derivation of the former from the latter is made, in the course of which the assumptions, approximations and restrictions tacitly involved in the equations of circuit theory are explicitly stated. The treatment is sufficiently extended as to show how the familiar equation for the simple oscillating circuit and the so-called telegraph equation can be deduced from the Maxwell-Lorentz statement of electromagnetic theory. AUTHOR.

1481. *Integrals of the Equations of Electrodynamics with an Application to the Electric Constants of a Transparent Medium.* **H. M. Macdonald.** (Roy. Soc., Proc. 113. pp. 237–253, Dec. 1, 1926.)—An analytical study is given of which the object is to express in terms of the electric current and magnetic current distributions the components of the electric force and those of the magnetic force as occurring in a suggested form of the equations representing Faraday's laws. Equations are given which can be used to represent the effect of a distribution of moving electric charges in a medium of given electric constants, and also the effect of a distribution of charges moving in free space. In studying the effect of a small transparent sphere on a train of waves a modified form of an analysis given by Lorenz is used to obtain expressions for the components of the electric force due to the sphere when the magnetic permeability is different from unity. A. B. C. L.

1482. *The Energy of an Electrified Particle According to Einstein's Modified Equations of the Field.* **N. R. Sen.** (Zeits. f. Physik, 40. 9. pp. 667–674, 1927.)—Assuming that an electrified particle has a definite bounding surface, it is shown that three-quarters of the total energy of the particle is associated with the electromagnetic field of the particle, whilst the remaining quarter is associated with its gravitational field. The constant of integration, customarily identified with the mass of the particle, is shown to be proportional to the total energy of the particle. J. S. G. T.

1483. *Existence of Sub-Electrons. Reply to Ehrenhaft's Remarks.* **J. Mattauch.** (Zeits. f. Physik, 40. 7. pp. 551–556, 1926.)—The objections raised by Ehrenhaft to the conclusions drawn by the author in his earlier work are considered in detail and finally rejected. [See Abstracts 2658 and 2659 (1926).] W. S. S.

1484. *Configuration of a Lorentz Electron Moving Arbitrarily Along a Straight Line.* **S. C. Wang.** (Phys. Rev. 28. pp. 1309–1314, Dec., 1926.)—In the first part of the paper, by a natural extension of the contraction hypothesis of a Lorentz electron in uniform motion to the case of arbitrary linear motion, a differential equation is obtained of the form $(\partial x/\partial \alpha)^2 + (\partial x/\partial u)^2 = 1$ (where $u = ct$, α and x are the distances of a point of the electron from its centre when it is at rest and when in motion respectively). It is then shown that this differential equation is invariant under a Lorentz transformation. In the second part the exact solution of this equation is obtained, satisfying also the condition that the motion of the centre of the electron shall be $x =$ any given function of u. AUTHOR.

1485. *Determination of the Electronic Charge from Measurements of the Shot-Effect in Aperiodic Circuits.* **N. H. Williams** and **H. B. Vincent.** (Phys. Rev. 28. pp. 1250–1264, Dec., 1926.)—An outstanding difficulty in the measurement of the electronic charge from the shot-effect in a tuned circuit has been the regeneration into this circuit. Former methods of dealing with that feature have added tedious computations to Schottky's original calculation. The solution presented here yields the result in such a form that much of the labour is eliminated; the solution is of great mathematical simplicity, and the measurement of the high-frequency resistance and resonance frequency becomes unnecessary. The treatment may be generalised to include the non-resonant case if the assumption be made that the resonance curve of the amplifier is symmetrical. A non-inductive resistance may be used as the medium of coupling, and experimental work with this system yields the mean result for the electronic charge of $4 \cdot 774 \times 10^{10}$ e.s.u. In work under conditions other than those of temperature limitation, the diminution of fluctuations seems to be due to high current densities rather than space charge in the region of the filament. AUTHORS.

1486. *Electrification of Dust Clouds.* **V. E. Whitman.** (Phys. Rev. 28. pp. 1287–1301, Dec., 1926.)—Dust clouds were formed by blowing various pure chemical substances through tubes and the net electric charge imparted was determined as a function of the composition of the dust, tube material, area of contact between dust and tube during the blowing process, velocity with which the dust moved through the tube, and length of path of the dust through the tube. An apparatus is described with which photographic records of the paths of particles in an electric field were obtained. Such photographs show the presence of positive, negative, and neutral particles in all dust clouds, even of very pure substances. The ratio of positive to negative electrification in a cloud is found to change as the larger particles in the cloud settle out, but evidence is obtained which contradicts the hypothesis that the large particles carry an opposite charge from the small particles in a given cloud. The paper closes with a few remarks bearing on the relation of the present experimental data to the concept of a triboelectric series. AUTHOR.

1487. *Electrostatic Charge on Glass Floats in Very Dry Liquids.* **H. V. A. Briscoe, P. L. Robinson** and **H. C. Smith.** (Phil. Mag. 3. pp. 63–64, Jan., 1927.)—During a series of tests on CCl_4 and BCl_3 to determine the density and thermal expansion by observations of flotation temperatures of calibrated glass floats, it was noticed that the floats became positively charged, if the liquid were agitated. The charge was probably due to friction between the liquid and the glass. The tendency to acquire the charge and the time required to dissipate it decrease with lapse of time, due probably to increased conductivity of the liquid. The effect was greater for CCl_4 than for BCl_3. R. S. R.

1488. *Detection of a Corpuscular Radiation of Cosmic Origin.* **W. F. G. Swann.** (Frank. Inst., J. 203. pp. 11–33, Jan., 1927.)—Experiments were made at Kew and Trondhjem (Norway) to measure the rate of charging of two thin copper vessels which were connected to one pair of quadrants of an electrometer. The copper vessels were surrounded by, but insulated from, two other concentric copper vessels which were connected to the opposite ends of a battery, shunted with a megohm, and with its central point connected to the case of the electrometer. The space between either pair of copper vessels could be filled with solid copper. The residual rate of deflection was found for six sets of observations at Trondhjem and one at Kew. The method of measuring the capacities is treated very carefully. It was found that the absolute magnitude of the current absorbed by a solid Cu cylinder is no more than 1·5 % of that which would have been obtained by the complete absorption of a vertical corpuscular current of density, sufficient to account for the replenishment of the earth's charge. It is stated that the positive charging of the Cu cylinder may be due to ejection of electrons from the air by the penetrating radiation. Some of these, reaching the earth, charge it to give equilibrium with the atmospheric electric conduction current. The views of Berndorf on residual positive and negative charges and of possible spontaneous radioactivity are discussed. R. S. R.

1489. *Maintenance of the Earth Charge by the Lightning Current.* **A. Wigand.** (Phys. Zeits. 28. pp. 65–69, Jan. 15, 1927.)—The unknown process whereby the negative earth charge is maintained and the vertical current of atmospheric electricity towards the earth kept in equilibrium has been widely investigated, but the physical nature of the continuous earthward flow of negative electricity requisite for maintaining the earth charge has not yet been satisfactorily determined. A critical examination of available observation material in order to test the question whether the negative earth charge can be maintained by a negative surplus charge of the total flashes reaching the earth shows that most of the flashes between earth and cloud are directed upwards. But for forming an estimate of the magnitude of the total current the existing data are insufficient and the calculations inconclusive. According to our present knowledge it is possible that the vertical transport of electricity caused by storms may effect compensation of the normal vertical current and so maintain the earth charge. [See Abstract 1168 (1925).] E. F.

DISCHARGE AND OSCILLATIONS.

1490. *Electrical Discharge in Mixed Gases.* **F. R. Terroux.** (Phys. Rev. 28. pp. 1242–1249, Dec., 1926.)—Spectra of argon, hydrogen and oxygen in the negative glow and positive column of a discharge tube containing $A - H_2$ and $A - O_2$ mixtures.—The following mixtures were used: (1) H_2 90 % — A 10 %, (2) H_2 50 % — A 50 %, (3) O_2 90 % — A 10 %, (4) O_2 50 % — A 50 %. Tables are given showing the principal lines in each region and their estimated relative intensities. In all four cases the change in concentration was found to make little difference in the distribution of electronic energy. In (1) the argon red spectrum is very strongly excited in the positive column, and the blue spectrum appears most intensely in the negative glow. A considerable number of electrons in the positive column possess energies of about 16 volts, while their energy in the negative glow reaches as much as 38 and 40 volts. In (3) and (4) the electrons on the whole possess energies of a higher order in both regions. The argon blue spectrum, the hydrogen Balmer series, and the oxygen series and elementary spectra predominate in the negative glow, whereas the argon red spectrum is most intense in the positive column. The behaviour of the Balmer lines in hydrogen and argon is the opposite of its behaviour in hydrogen and helium. The striated state was produced in every mixture, and abrupt changes in the discharge occurred when the pressure was reduced to critical values. The rotation of inclined striæ is connected with the intermittency of the discharge. AUTHOR.

1491. *Theory of the Kathode Dark Space.* **A. Güntherschulze.** (Zeits. f. Physik, 40. 7. pp. 545–547, 1926.)—Seeliger recently discussed [see Abstract 763 (1927)] two theories of the kathode dark space and concluded that the " field " theory gives a more satisfactory explanation of the phenomena at the kathode than the " excitation " theory. The author of the present paper opposes this view and cites research by Wehnelt and Jachan in support of the excitation theory. According to Seeliger this research was difficult to explain on the excitation theory, but the present author considers the results of the research may be explained without much difficulty on his theory, and suggests further consequences of the theory which may be tested experimentally. A. W.

1492. *Penetration of Solid Insulators.* **Lidia Inge, N. Semenoff** and **A. Walther.** (Archiv f. Elektrot, 17. pp. 433–454, Jan., 1927.)—It is here proved that at high temperatures the penetration of rock-salt and glass is a temperature effect and most of the theoretical demands of the theory of heat are fulfilled. It is shown that with the passage to lower temperatures from a certain temperature the heat effect is replaced by an ionisation effect. The influence which the polarisation phenomena set up in the dielectric at low temperatures has on the course of the penetration tension is pointed out, and it is attempted to explain theoretically the mechanism of the penetration by alternating current and impact tensions. [See also Abstracts 2150 (1925) and 2169 (1926).] A. E. G.

1493. *Sparking Potential.* **F. Klingelfuss.** (Ann. d. Physik, 82. 2. pp. 275–304, Jan. 12, 1927.)—The sparking potential between two electrodes is represented as the sum of two functions, one being a linear function of the width of gap and the other the electrode function which is constant for all gap widths above a certain value, but below this value it varies according to an exponential equation. The curves calculated from the above relations agree closely with experimental values. Discrepancies which are found in certain cases, particularly for small gap widths (less than 1 c.m.), will be further investigated. The formula here used may be transformed to another in agreement with Townsend's laws. A. W.

1494. *Scattering of Positive Rays by Gases. Part II.* **G. P. Thomson.** (Phil. Mag. 2. pp. 1076–1084, Nov., 1926.)—These experiments are in continuation of those previously described [see Abstract 2160 (1926)]. It is found that argon and helium show a maximum of scattering for a certain velocity of proton ($0{\cdot}75 \times 10^8$ and $1{\cdot}4 \times 10^8$ respectively). This result appears to be analogous to those of Ramsauer and other workers with electrons of about the same speed, but is still more difficult to reconcile with the ordinary mechanical models of the atoms concerned. The experiments are consistent with a collision relation of the form $A\theta^{-1{\cdot}35}$ in the case of both helium and argon, the index being independent of the speed. A few experiments on oxygen show large scattering but apparently no maximum. A. E. G.

1495. *Dispersion of Corpuscular Rays as Diffraction Appearances.* **G. Wentzel.** (Zeits. f. Physik, 40. 8. pp. 590–593, 1926.)—In the limiting case of classical mechanics the amplitude square of the Schrödinger matter waves is identical with the volume density of the mass point of a stationary corpuscular current. In the special diffraction problem which corresponds to the dispersion of α-rays, the first step of an approximation behaviour given by Born [see Abstracts 2532 (1926) and 43 (1927)] supplies exactly the Rutherford direction distribution. A. E. G.

1496. *Remarks on a Paper by R. Conrad on the Absorption of Hydrogen Canal Rays in Hydrogen.* **G. P. Thomson.** (Zeits. f. Physik, 40. 8. p. 652, 1926.)—Clears up some misunderstandings of Conrad with regard to the author's previous work on the subject, showing that in his second paper he has fully considered the conditions for simple single scattering; points out that the multiple scattering effect, if sensible, diminishes when the scattering angle increases, while the difference between theory and experiment is greatest for large angles; shows that with the thermoelectric method employed by Conrad great accuracy cannot be expected, as the total deflection of the galvanometer is small and only a fraction of this is due to the scattering. The range of velocities employed is regarded as being too small. [See Abstract 439 (1927).] H. N. A.

1497. *Natural Ionisation in Spherical Containers; Theoretical Considerations.* **J. W. Broxon.** (Phys. Rev. 28. pp. 1071–1085, Dec., 1926.) —The variations with the pressure and the size of the container of the natural ionisation in gases in spherical containers are explained in terms of simple radiations. These radiations differ chiefly with regard to their origin and range. Radiations with equal propagation in all directions, uniform ionisation along a path, and with ranges either greater or less than the diameter of the sphere, are considered with origin either throughout the volume or at the inner surface of the container. Radiations are also considered with origin at the inner surface of the sphere, direction normal to the surface, and absorption exponential with the distance traversed. The observed pressure variation of the natural ionisation in air is given accurately by the formulæ derived, upon assuming the ionisation to be due entirely to the secondary and tertiary radiations excited in the gas and its container by a primary penetrating radiation. The volume variation is given qualitatively but not quantitatively in this instance, and the constants are interpreted. The pressure variation in the case of carbon dioxide is also closely approximated. [See also Abstract 2432 (1926).] AUTHOR.

1498. *A Velocity Filter for Electrons and Ions.* **W. R. Smythe.** (Phys. Rev. 28. pp. 1275–1286, Dec., 1926.)—If a charged particle moving along the x-axis with a velocity v encounters successively two identical alternating electric fields of frequency ν which are everywhere perpendicular to the x-axis, it will emerge from the last field undisplaced and travelling in the original direction under the following conditions: (1) Each field has two similar halves whose distance between centres is a; (2) the distance between the fields, centre to centre, is $D = sa/n$, where s and n are odd integers; and (3) the velocity of the particle is $v_0 = 2\,av/n$. The distribution about the velocity v_0 is computed when particles enter and leave the system through slits of width y_0 on the x-axis. The results show that the emergent beam can be confined to a very narrow velocity range. Possible applications of the velocity filter, chiefly to positive-ray work, are mentioned. It has already proved a successful and convenient substitute for pure magnetic analysis. It can be used to analyse a beam which is inhomogeneous both in mass and velocity when combined with either electric or magnetic deflection methods. The latter combination can be arranged to give a rigorously linear mass scale. AUTHOR.

1499. *The Dependence of the Number of Photoelectrons on the Wave-Length and Intensity of the Exciting Light.* **A. W. Uspensky.** (Zeits. f. Physik, 40. 6. pp. 456–473, 1926.)—Becker [see Abstract 370 (1926)] gives the empirical formulæ $f(\lambda) = \text{const.}\ (1 - \lambda/\lambda_0)^2$ and $f\lambda = \text{const.}\ (1 - \lambda/\lambda_0)^3$, where λ_0 is the red limit of activation.

This paper is an attempt to give a theoretical treatment on the assumption that every quant releases an electron with a velocity given by $\frac{1}{2} mu^2 = h\nu$, and that all possible directions of emission are equally probable. The formula obtained finally is

$$\frac{\text{Coulombs}}{\text{Calories}} = 340.10^{10}\frac{1}{\nu}\left(\sqrt{\frac{\nu}{\nu_0}} + \sqrt{\frac{\nu_0}{\nu}} - z\right),$$

where coulombs refers to photoelectric output and calories to exciting energy. A comparison with Suhrmann's [see Abstract 1687 (1922).] experimental results is made showing good agreement. **Errata** (*ibid.*, 41. 11–12. p. 931, 1927). J. E.

1500. *Theory of Photoelectric Effects.* **G. Wentzel.** (Zeits. f. Physik, 40. 8. pp. 574–589, 1926.)—Under the forced oscillations calculated by Schrödinger which a light wave produces in an undulatory mechanics atom there is found also the proper oscillation of the continuous spectrum which correspond to the electron current issuing from the atom. Schrödinger's disturbance formula therefore allows the probability of calculating the photoelectric process. If the impoverishment of the inner atom by an electric charge $|\psi|^2$ is considered it gives the spherical waves corresponding to the photoelectrons as damped waves, the crest of which is propagated with the true electron velocity. The value of the intensity of the ψ-wave for bound electrons similar to hydrogen is obtained, and the results are in complete accord with experiment. The direction distribution of the photoelectrons is considered, and it is found that the intensity is proportional to $\cos^2 \theta$, where θ is the angle between the direction of propagation and the electric light vector. A formula is obtained for finding the value of the absorption coefficient μ of X-rays. In the magnetic spectrum of the photoelectrons the intensity ratio $(L_{22} + L_{21})/L_{11}$ is proportional to λ/λ_L. [See also Abstracts 2532 (1926) and 43 (1927).] A. E. G.

1501. *Photoelectric Electron Emission and the Optical Absorption Ability of Potassium in Dependence on the Gas Content of the Metal.* **R. Fleischer.** (Ann. d. Physik, 82. 1. pp. 75–86, Dec. 16, 1926.)—In the first part of this paper the author undertakes to reproduce the results obtained by himself and Dember by the direct introduction of gas. Hydrogen is the gas chosen in this case. Measurements are carried out on linear polarised light with the electric vector at first parallel to and then at right angles to the plane of incidence. In the second part, with the help of cells in the form of black bodies, for the photoelectric electron emission in respect to absorbed light units, the characteristic normal and selective curves are obtained direct from measurements of electron emission in dependence on the wave-lengths. A. E. G.

1502. *Influence of Oxygen on the Optical Powers of Absorption and on the Photoelectric Electron Emission of Potassium.* **R. Fleischer.** (Ann. d. Physik, 82. 2. pp. 243–253, Jan. 12, 1927.)—The earlier optical and photoelectric measurements on degassed potassium are here confirmed. While in the earlier experiments by degassing potassium the maximum of the optical absorption and the maximum of the photoelectron emission in respect to the units of the incident light could be displaced to wavelength 313 $\mu\mu$, it has now been able to displace it to 302 $\mu\mu$. The spectral situation of the selective photoelectric electron emission of potassium is dependent on the kind of gas absorbed. It is shown that the photoelectric maximum of potassium-oxygen mirrors at 313 $\mu\mu$ cannot only depend on the optical absorption. The optical absorption of the potassium-oxygen mirrors is not essentially different from that of the degassed potassium mirrors, to the degassed condition of which the appearance of the optical absorption maximum at 313 $\mu\mu$ corresponds. A. E. G.

1503. *General Characteristics of Electrically Exploded Wires.* **J. A. Anderson** and **S. Smith.** (Mt. Wilson Observat. Contrib. No. 323. Astrophys. J. 64. pp. 295–314, Dec., 1926.)—A general discussion of the condenser circuit shows that efficiency in producing high temperatures with the method of electrically exploded wires requires primarily high voltage; secondarily, large capacity and low inductance. The value for the resistance of the wire is $\sqrt{L/C}$, and the resistance of the rest of the circuit should be negligible. Several methods of studying the explosions are outlined: (1) From direct photographs the temperature of the vapour may be measured when its pressure is equal to that of the surrounding atmosphere. (2) A convenient form of rotating-mirror camera is described which is well adapted for studying sparks or explosions in circuits whose frequency is not much greater than 10^6 cycles. (3) Rotating-mirror spectrograph. (4) Velocity-of-sound method. (5) Optical focal-plane shutter. In the mechanical focal-plane shutter the image is stationary while the shutter moves. This is reversed in the present apparatus. Photographs made with this apparatus showing various phases of explosions are reproduced. (6) Magneto-optic shutter. Photographs of an early stage of the explosions are reproduced and briefly discussed. (7) Parallel spark gap. The appearance of explosions at the very beginning indicate that the particles evaporating from electrically heated wires at high temperatures are charged. A. E. G.

1504. *An Effect of Light on the Electron Emission from Hot Filaments.* **W. H. Crew.** (Phys. Rev. 28. pp. 1265–1274, Dec., 1926.)—The increase in the electron emission from hot, oxide-coated platinum filaments when illuminated by the full radiation from a water-cooled quartz mercury arc was measured, for different filament temperatures, as a function of potential between filament and anode. The photoelectron currents were large enough to be readily measurable with a galvanometer. Measurements on one filament showed the photoelectron current increasing with potential to a maximum at about 14 volts. For another filament, twice as thick, the maxima were between 2 and 4 volts. In the case of both filaments increasing the temperature shifted the maximum to lower values of potential. No photoelectric fatigue was observed. By the use of various absorbing screens and different sources of light it was found that the photo-currents are, for the most part, due to radiations of wave-lengths shorter than λ3000, but that the long wave-length limit is somewhat above that value. In all, four types of filaments were tried: (*a*) oxide-coated platinum; (*b*) plain platinum; (*c*) oxide-coated tungsten; (*d*) plain tungsten. Of these, only the oxide-coated filaments gave an appreciable emission due to the light. The possible source of the photoelectrons is discussed and calculations are made as regards their velocity distribution. Results suggest that the action of the light is to free electrons from a thin film of metal of which the work-function varies with the temperature of the filament. AUTHOR.

1505. *Escape of Electrons from Metals under the Action of High Field Strength.* **G. Hoffmann.** (Ann. d. Physik, 82. 2. pp. 254–256, Jan. 12, 1927.)—In a recently published paper of F. Rother [see Abstract 2940 (1926)] the differences between his experimental results, which had appeared in an earlier work, and those of the present author are very largely removed. Rother now finds his results in good agreement both qualitatively and quantitatively with those of Hoffmann. The present paper is a comment on the work of Rother. A. E. G.

1506. *Ionisation by Electrons in a Homogeneous Electrical Field.* **F. M. Penning.** (Zeits. f. Physik, 40. 1–2. pp. 4–9, 1926.)—The calculations of Hertz [see Abstract 2139 (1925)] on the diffusion of electrons and the measurements of Compton and van Voorhis [see Abstract 2174 (1926)] on the ionising probability are here used in connection with movement of electrons in a homogeneous electrical field. The number of collisions, the loss of energy by elastic collisions, and the number of ionisations per unit of length are calculated. The results are obtained on a discharge in neon. A. E. G.

1507. *Lattice Energy and the Work of Setting Electrons Free in the Case of Calcium.* **J. J. Weigle.** (Zeits. f. Physik, 40. 7. pp. 539–544, 1926.)—The lattice energy of calcium is here calculated from the assumption that the electrons in metallic calcium are arranged in a lattice which is built up analogous to the F^--ion lattice in CaF_2. This result is in moderately good accord with that obtained by calculation from the heat of sublimation and ionising tension. The work of the escape of electrons in the case of calcium is calculated and is found to agree with experimental results. A. E. G.

1508. *An Experimental Proof of the Thermal Ionisation of the Elements.* **M. N. Saha, N. K. Sur** and **K. Mazumdar.** (Zeits. f. Physik, 40. 8. pp. 648–651, 1926.)—The problem is of importance from the point of view of astrophysics, and attempts have previously been made by Saha and Günther and by Saha and Sur to show experimentally that various elements are ionised at high temperatures. In both cases the vapours were heated in electric ovens, and there appeared to be a possibility that in certain parts of the interior a potential drop might be present exceeding the ionisation voltages of the elements concerned and that the observed ionisation was due to electronic bombardment. The experiments have been repeated using a new form of furnace formed of a graphite tube through which a heavy current at low voltage from a step-down transformer is passed. The temperature can easily be maintained at 2000° C. Current through the ionised vapour passes between two parallel graphite plates inside the tube, the potential difference being only 1 volt. With Hg, Zn and Cd no current is obtained; with Mg the galvanometer shows a small deflection; with Na and K the deflections are very large, and the currents could only be measured with a milliammeter. These results agree with the ionisation voltages of the elements employed, and further details are promised. H. N. A.

1509. *Atmospheric Ionisation.* **J. J. Nolan** and **G. P. de Sachy.** (Roy. Irish Acad., Proc. 37. pp. 71–94, Jan., 1927).—In a previous paper [see Abstract 1713 (1925)] it was shown that about 40 % of the atmospheric nuclei of condensation were uncharged, the remainder being positive and negative large ions carrying unit electronic charges. In this paper the problem of equilibrium of ionisation is examined without assuming equality of concentration of the two signs. The small atmospheric ions are found to be a mixture of ions of different mobilities, *viz.*, of the Langevin ions and those similar to the ions produced by the spraying and bubbling of liquids. The equilibrium concentrations are given for different conditions. For the conductivity of the lower layer of the atmosphere at Dublin a rough calculation based on the data gives $\Lambda = 0\cdot45 \times 10^{-4}$ e.s. units. H. H. Ho.

1510. *Theory of Ions and Passage through Gases.* **W. O. Schumann.** (Zeits. techn. Physik, 7. 12. pp. 618–623, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926)—This paper gives a synopsis of the more recent work on the setting up of a gas discharge and on the corona loss. A. E. G.

1511. *Explanation of Appearances with Kathode Scattering.* **T. Baum.** (Zeits. f. Physik, 40. 9. pp. 686–707, 1927.)—As the result of experiments here described it is concluded that the emitted particles in kathode scattering are uncharged atoms, and that these can take on a charge in glow light. The order of magnitude of their velocity is determined by magnetic deflection, and it is found to be that of vaporising atoms. A. v. Hippel [see Abstract 190 (1927)] by means of indirect spectroscopic research has reached the same conclusions with respect to magnitude and charge. The deviation of the measured values from those calculated from theory is investigated, and it is found that the condition of the surface of the kathode has a marked influence on the amount of scattering, and that the surface of the kathode alters in a manifold manner during the course of the experiment. A. E. G.

1512. *Electricity in Flames.* **J. A. J. Bennett.** (Phil. Mag. 3. pp. 127–146, Jan., 1927.)—The main object of the experiments described in this paper is to find how the electrical conductivity of a Bunsen flame containing alkali salt vapours varies with the temperature. The temperature of the flame is varied by altering the gas supply and by the addition of carbon dioxide. A full description of the apparatus with diagrams is given and the work is divided into the following sections: (1) Electrical conductivity of flames containing alkali salt vapours, including measurement of the temperature of the flame, measurement of the velocity of the flame, amount of salt in the flame, specific conductivity of the flame, variation of the conductivity of the flame without salt with temperature, calculation of the ionisation potential of salt-free flame from temperature variation, and variation of the conductivity of cæsium chloride and rubidium chloride with temperature and concentration. (2) The thermal ionisation of gaseous elements at high temperatures—a confirmation of the Saha theory. (3) Velocity of electrons in a Bunsen flame. A. E. G.

1513. *Theory of the Radiation Field.* **E. Spenke.** (Ann. d. Physik, 82. 1. pp. 155–160, Dec. 16, 1926.)—This paper is concerned with an extension of the work of Kiebitz [see Abstract 203 (1927)] for rotationally symmetrical radiation fields. It is shown that in such fields with no losses the lines of the field are circles whose centres lie in the axis of symmetry and which are perpendicular to the surface of the conductor. A. W.

1514. *A Method of Transmission for Short Waves.* **N. Korshenewsky.** (Zeits. techn. Physik, 7. 12. pp. 594–598, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The author discusses the effects of the position of the ionised upper layer, the angle of incidence of the rays at this layer, and the orientation of the plane of polarisation in the reception of electromagnetic waves. The advantage of circular polarised over linear polarised oscillations is pointed out, and a method of generating circular polarised waves given. The apparatus consists of two aerials, perpendicular to each other, each being excited from the same valve oscillator but with a phase difference of 90°. The weakening of the received signal by the interference of two or more rays, arriving by different paths, is also discussed. E. T. A. R.

1515. *Generation of Oscillations with Double-Grid Valves.* **E. Alberti.** (Zeits. techn. Physik, 7. 12. pp. 592–594, 1926. Paper read before the

Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—With an arrangement very similar to that used for an arc generator it is shown that oscillations can be produced and maintained with a double-grid valve. A condenser and inductance in series are connected between the first grid and the negative end of the filament, and a battery is connected through chokes to the same two points, the grid being connected to the positive pole. A second condenser is connected in parallel with the first condenser and inductance and adds to the valve capacity. A second battery has its positive terminal connected to the negative end of the filament and its negative to the second grid. The wave-lengths obtained with this arrangement were in good agreement with calculated values, but without the parallel condenser the agreement was not so good owing to the uncertainty of the values of the valve capacities. With an R-type amplifying valve, measurements of the wave-length gave a value of 95 cm. A. W.

1516. *Forced Oscillations in a Circuit with Non-linear Resistance.* **B. van der Pol, Jr.** (Phil. Mag. 3. pp. 65–80, Jan., 1927.)—If a triode system which is reaction-coupled beyond the critical point is acted upon by a signal in the form of a continuous wave, the circuit must satisfy the following equation (secondary factors being eliminated): $\ddot{v} - (\alpha - 3\gamma v^2)\dot{v} + \omega_0^2 v = B\omega_1^2 \sin \omega_1 t$, in which the non-linear term containing γ is essential in order to represent the experimental facts. In the absence of an external e.m.f.—*i.e.*, without the right-hand term—this equation gives a free oscillation of frequency ω_0 having a constant amplitude determined by $a_0^2 = \alpha/\frac{3}{4}\gamma$. If an external e.m.f. is present, forced and free oscillations are found in varying degrees, depending on the closeness to the resonance region. Near the resonance region only forced oscillations exist, the free oscillations being suppressed by the forced. The limits of stability of this suppression are investigated in detail.

A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1517. *Method of Measuring the Thomson Effect at Different Temperatures.* **Bianca Nannei.** (N. Cimento, 3. 8. pp. 438–468, Dec., 1926.)—The first part of the paper is mathematical and devoted to finding expressions for the temperature of a linear conductor traversed by an electric current. The problem is the experimental determination of the coefficient σ of the Thomson effect corresponding to a certain conductor, the coefficients of thermal and electric conductivity corresponding to each temperature being eliminated. The experiments were made with an apparatus, of which an illustration is given, consisting of an electrically heated steel tubular conductor. The value found for σ/k agrees with the results of other experimenters. In order to calculate finally the value of σ it is necessary to determine k (the coefficient of internal thermal conductivity), but the apparatus employed did not admit of this being satisfactorily measured. If, however, we put the value of k at 0·11, which corresponds to ordinary non-tempered steel such as was used for the tube, we get for the value of σ 0·00000105 referred to a current of 1 ampere. The sign of σ must be negative, seeing that an electric current coinciding in direction with the thermal current produces in iron and steel a lowering of temperature. E. F.

1518. *Ponderomotive Forces on a Dielectric.* **W. Dällenbach.** (Phys. Zeits. 27. pp. 632–635, Oct. 15, 1926.)—The author discusses the problem of the ponderomotive forces on a stationary dielectric in a constant electric field, criticises the standard formula of H. A. Lorentz, and deduces a new formula the results of which differ from the former only in the distribution of the elastic tensions. A. D.

1519. *Thermoelectric Properties of Metallic Solid Solutions.* **A. L. Norbury.** (Phil. Mag. 2. pp. 1188–1198, Dec., 1926.)—Using wires prepared by a method previously described [see Abstract 2352 (1925)], the e.m.f. set up at temperatures between − 191° and 500° C. by certain Cu*a* solid solution alloys when coupled against Cu are determined. The Ag alloys show least and the Ni alloys the greatest development of e.m.f. throughout the temperature range. The respective alloys containing Zn, Al and Sn form an intermediate group, all the curves connecting temperature and e.m.f. generated being relatively simple and similar in nature. The Mn alloys yield curves of a different type from all the others, the e.m.f.'s having small minimum values in the neighbourhood of 100° C., beyond which range all values are positive. A comparison is given of the effects of equiatomic quantities of elements in solid solution on the thermoelectric properties of Cu and certain other metals. A thermoelectric formula of a new type, $e = -a + b\mathrm{T} + c.\ 10^{-d\mathrm{T}}$, a, b, c, d being constants depending on the thermocouple and on the cold junction temperature, is found to express the results closely over a wide temperature range. A. B. C. L.

1520. *Dielectric Constant of Symmetrical Polyatomic Dipole Gases.* **R. de L. Kronig.** (Nat. Acad. Sci., Proc. 12. pp. 608–612, Oct., 1926.)—Determination of the dielectric constant of a rigid polyatomic molecule possessing an axis of symmetry, with a permanent electric moment μ, by quantum methods. Just as in the case of diatomic molecules [see Abstract 210 (1927)], the permanent moment of the molecules and the part of the dielectric constant due to it are related by Debye's equation derived on the classical theory, provided the temperature is sufficiently high. A. D.

1521. *Dielectric Constants of Liquid and Solid Nitrogen.* **L. Ebert** and **W. H. Keesom.** (K. Akad. Amsterdam, Proc. 29. 9. pp. 1188–1192, 1926.)—The determinations made are of a preliminary character, particularly with reference to those made on solid nitrogen, in which hollows, and possibly anisotropic effects due to special orientation of crystals, are suspected. Values obtained for ϵ lie in the neighbourhood of 1·45. A. B. C. L.

1522. *Dependence of the Dielectric Constants of Some Liquids on Pressure up to* 3000 *kg./cm.*^{2} **S. Kyropoulos.** (Zeits. f. Physik, 40. 7. pp. 507–520, 1926.)—The following liquids were examined: Ethyl ether, carbon disulphide, chloroform, petrol ether, acetone, ethyl alcohol, methyl alcohol, water, pyridine, carbon tetrachloride and benzol. Their dielectric constants were determined by means of undamped vibrations of $\lambda \backsim 350$ m. at 20° C., and for some of the most important the course of the Lorenz-Lorentz ratio was calculated. The apparatus for generating the pressure was a modified form of that used by Tammann in his researches on crystallisation and fusion. The results are set forth in great detail in numerous tables. E. F.

1523. *Influence of a Magnetic Field on the Dielectric Constant of a Diatomic Dipole Gas.* **L. Pauling.** (Phys. Rev. 29. pp. 145–160, Jan. 1927.)—The investigation of the motion of a diatomic dipole molecule in crossed magnetic and electric fields shows that according to the old quantum theory there will be spatial quantisation practically with respect to the direction of the magnetic field for experimentally realisable values of the field strengths. As a result of this the old quantum theory definitely requires that the application of a strong magnetic field to a gas such as hydrogen chloride should produce a very large change in the dielectric constant of the gas. The theory of the dielectric constant of a diatomic dipole gas according to the new quantum mechanics, on the other hand, requires the dielectric constant not to depend upon the direction characterising the spatial quantisation, so that no effect of a magnetic field would be predicted. The effect is found experimentally not to exist, so that it provides an instance of an apparently unescapable and yet definitely incorrect prediction of the old quantum theory. [See also Abstract 1109 (1926).] AUTHOR.

1524. *A Direct-Current Vibration Galvanometer Method.* **P. Kirkpatrick.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 613–619, Nov., 1926.)—If a key controlling a galvanometer circuit be periodically opened and closed at intervals of one-half the period of the instrument, a suitable potential source being provided, the suspended system will execute a few oscillations of increasing amplitude, but will soon attain a maximum which will be maintained for all succeeding oscillations. If a reversing switch be installed in place of the simple key, and the operation be such that a properly directed driving current always flows through the suspended coil, a maximum amplitude larger than in the previous case will be observed. The maximum is found to be proportional to the applied voltage so long as the resistance of the galvanometer circuit is kept constant, and increases with increase of resistance if the current be held at a fixed value. An experimental verification is given for this theory. E. G.

1525. *Anderson Bridge for Measurement of Self-Inductances.* **C. Günther.** (Zeits. Instrumentenk. 46. pp. 623–631, Dec., 1926.)—A description of a bridge of the Anderson type for the measurement of self-inductance. The design aims at compactness and simplicity rather than accuracy. Self-inductances down to 10^{-4} henry may be measured, and the error is of the order of several per cent. Two of the resistances forming the bridge consist of the two sections of a slide-wire. Zero adjustment is obtained by varying the capacity of the condenser. The source of e.m.f. consists of a small coil fitted with a make-and-break arrangement, and the frequency may be varied from 250 to 400. A telephone is used for obtaining balance, the sensitiveness being improved by the use of a thermionic triode amplifier. A. H.

1526. *The Natural Observation Limits of Current Strength.* **F. Zernike.** (Zeits. f. Physik, 40. 8. pp. 628–636, 1926.)—The author has established by calculation that Ising's limits for galvanometer sensitiveness [see Abstract 1909 (1926)] which are considered to be independent of the measuring processes are conditioned by spontaneous current fluctuations. These fluctuations had long been observed with the most sensitive of needle galvanometers, but remained inexplicable, and in the present paper experiments are described and the theoretical treatment worked out whereby the fluctuations are established with the moving-coil galvanometer. H. H. Ho.

1527. *A New Relay for Very Weak Currents.* **H. Richter** and **H. Geffcken.** (Zeits. techn. Physik, 7. 12. pp. 601–606, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The paper describes a new gas-discharge relay which operates with the ignition of a glow discharge, and has consequently an unstable characteristic. It consists of an anode and kathode between which there is a central electrode contained in an enclosure filled with an inert gas; the gas pressure is such that a blue glow discharge is obtained when the potential of the intermediate electrode exceeds the critical value. The primary current is about 10^{-8} to 10^{-10} ampere, and the secondary 20 to 50 milliamperes. Some examples of the use of the relay are given, including the detection of light with the aid of photoelectric cells and the reception of high-frequency currents. E. T. A. R.

1528. *Selenium Cells.* **H. Thirring.** (Phys. Soc., Proc. 39. p. 97, Dec., 1926.)—A brief description of the performance (not the construction) of cells of the condenser type with small light-sensitive areas. The current ratio (100 m.c./darkness) varied from 60 to 6 for the different cells. J. W. T. W.

1529. *A Braun Electrometer for Voltages up to* 18,000 *Volts.* **M. Neunhöffer** and **K. Steiner.** (Phys. Zeits. 28. pp. 23–24, Jan. 1, 1927.)—A form of Braun electrometer for the measurement of voltages from 2500–18,000 volts with an accuracy of about 30 volts is very briefly described. J. S. G. T.

ALTERNATING CURRENTS AND MAGNETISM.

1530. *Distribution of Alternating Currents in a Ferromagnetic Cylinder.* **D. Graffi.** (N. Cimento, 3. 8. pp. 421–437, Dec., 1926.)—Taking Piola's representation of the hysteresis cycle as a starting point the author mathematically examines the problem of the skin effect and obtains the following results: (1) The skin effect is increased by hysteresis; (2) even when the applied electromotive force is sinusoidal the resulting current is not sinusoidal, which agrees with experiment; (3) the reactance of the sine depends on the intensity of the current flowing along it. E. F.

1531. *The Micromagnetic Field.* **F. Ehrenhaft.** (Phys. Zeits. 27, pp. 859–869, Dec. 15, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The paper is on the motion of minute particles of matter in a magnetic field [see Abstract 1663 (1926)]. After summarising previous work which shows that the particles are spherical and that their mobilities are determinable, an inhomogeneous magnetic field is employed in observing small particles of silver, selenium and $FeCl_3$ solution between the plates of an Ehrenhaft condenser. The mass-susceptibilities derived from the observations agree with those already found for the molar material. The fundamental magnetic properties are thus shown to exist in submicroscopic particles. [See also Abstract 531 (1927).] G. E. A.

1532. *The Micromagnetic Field.* **F. Ehrenhaft** and **E. Wasser.** (Zeits. f. Physik, 40. 1–2. pp. 42–53, 1926.)—For a preliminary communication on the subject by Ehrenhaft see Abstract 1663 (1926). The plates of a special Ehrenhaft condenser are constructed in such a way that they can be used as the poles of a powerful electromagnet, so that either a vertical electrostatic field or a vertical magnetic field can be formed between them. The magnetic field increases rapidly downwards so that a minute test particle of paramagnetic material is acted on by a magnetic force vertically downward in addition to its weight and it falls more rapidly when the field is switched on; the magnetic force on a diamagnetic test particle is vertically upwards and it falls less rapidly in the magnetic field than without it. Test particles whose order of magnitude is 10^{-5} cm. are made use of, and for calibration minute drops of a solution of $FeCl_3$ of known concentration are employed; by observing their rate of movement in different parts of the field, the field intensities and those of the remanent magnetic field can be determined as functions of the distances from the poles. It is also possible to deduce the mass susceptibilities of other test particles, and selenium and silver have been investigated; the susceptibilities determined in this way agree with those found for large masses of the substances using ordinary methods. H. N. A.

1533. *Magnetic Susceptibilities of Gases at Low Pressures.* **V. I. Vaidyanathan.** (Indian J. of Physics, 10. pp. 183–198, Dec., 1926.)—By means of a balance immersed in CO_2, the volume susceptibility of this diamagnetic gas is found proportional to the pressure from 0 to 700 mm. This holds also for the paramagnetic gases oxygen and air, which were tested against a standard solution. [See Abstract 607 (1925).] G. E. A.

1534. *Magnetic Susceptibilities of Compounds.* **Sophie Berkman** and **H. Zocher.** (Zeits. phys. Chem. 124. pp. 318–326, Dec. 30, 1926.)—Using a torsion method, the susceptibilities of a large number of compounds of elements which are neighbours in the periodic system were measured. Iron carbonyls and ferrotri-α-α-dipyridyl sulphate are diamagnetic, whilst two other complex iron salts and colloidal iron hydroxide are strongly paramagnetic. Of ten complex cobalt salts only two were paramagnetic, but three $Cr^{\cdots}$ salts were strongly paramagnetic. Seven organic dyes tested were diamagnetic. G. E. A.

1535. *Magnetostriction.* **L. W. McKeehan.** (Frank. Inst., J. 202. pp. 737–773, Dec., 1926.)—This paper is a summary of three lectures delivered for the Bartol Research Foundation in April 1926. The earlier part is devoted to an historical survey of the subject and deals with the work of Joule, Kelvin, Bidwell, Ewing, Knott, etc. These earlier results are exceedingly complex and very difficult to reconcile, sometimes because of the doubtful composition of the material used, and sometimes because of the unsuitable experimental methods. In consequence the subject field has come to be regarded unjustly (according to the writer) as somewhat barren from the viewpoint of ferromagnetic theory. The discovery of the remarkable magnetic properties of those alloys of iron and nickel known as permalloy and the magnetostriction effects observed in such alloys provide the writer with material upon which he founds a new theory of ferromagnetism. The principal experimental fact to be noted is that in an alloy containing about 20 % of iron the magnetostriction effect is practically absent, and it is in this alloy that saturation is produced by the feeblest fields. He therefore supposes that in ordinary ferromagnetic materials (iron, nickel, etc.) there is at all points a kind of atomic strain due to the mutual magnetic forces of neighbouring atoms. Magnetisation modifies these forces and leads to a dissipation of energy (hysteresis). But in permalloy the iron and the nickel atoms are so arranged in the lattice that in turning very little disturbance is produced, and so easy saturation and low magnetostriction result. These views are supported by the citation of experiments on typical materials. A. A. D.

1536. *Hysteresis Losses with Strong and Weak Magnetisation.* **U. Meyer.** (Zeits. techn. Physik, 7. 12. pp. 606–609, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The variation of hysteresis loss with field strength follows one law in weak and a different law in strong fields. The two laws are respectively Jordan's [see Abstract 2840 (1924)] and Steinmetz's. It is possible to find a material which, as regards hysteresis, is good in strong fields but not good in weak fields, and *vice versa.* In order to find a common criterion for strong and weak current technique, the author suggests the employment of a " hysteresis number," defined as losses ÷ BH. The variation of the hysteresis number with H is graphed and is shown to follow roughly a course similar to the μ-H graph. G. E. A.

1537. *Studies on Precipitated Magnetite, with Particular Reference to Hysteresis.* **L. A. Welo** and **O. Baudisch.** (Phil. Mag. 3. pp. 396–410, Feb., 1927.)—Three methods of preparation are given which result in different-sized crystals with different catalytic activity and absorptive powers for water. The magnetic properties are described. It is concluded that although the samples differ as to hysteresis, there is no direct relation between this and crystal size. This is in conformity with Gerlach [see Abstract 1914 (1926)]. All three give identical X-ray patterns which are used in the determination of crystal size. A new method of preparing magnetite is given. J. E.

1538. *The Ferromagnetism of Nickel, and the Quantum State of its Atoms.* **D. Rožansky.** (Phys. Zeits. 27. pp. 779–787, Dec. 1, 1926.)—Starting with Weiss's idea of a molecular field, an attempt is made to determine the quantum state of the atoms in nickel. Two atomic conditions are regarded as indicative of the actual ferromagnetic behaviour, namely, those corresponding to the s and d_2 terms. By means of a new hypothesis, the number of ferromagnetic atoms is determined; this number varies from 25 % of all the nickel atoms at very low temperatures to 40 % in the region of the Curie point; thereafter the proportion diminishes. The temperature of the Curie point is found to be 631·8 absolute for nickel. G. E. A.

1539. *Paramagnetism of the Elements between Ca and Zn.* **A. Carrelli.** (Accad. Lincei, Atti, 5. pp. 569–574, Dec., 1926.)—A discussion of the magnetons of Weiss and Bohr and Kossel's curve leads to the conclusion that, similarly to the rare earths, the group of elements between Ca and Zn shows a double period of variation in the number of magnetons as a function of the atomic number. That this double periodicity is not revealed in Kossel's curve is evidently due to the fact that the curve was determined on the basis of measurements of magnetic susceptibility, the elements being in solution in the state of ions. [See also Abstracts 173 and 687 (1926).] E. F.

1540. *Vertical-Intensity Magnetometer.* **D. la Cour.** (Terrest. Magn. 31. pp. 153–163, Dec., 1926.)—The essential part of the instrument is a precise standard of mutual inductance, *i.e.*, an inductor with two sets of windings. The throw obtained with a Broca galvanometer used ballistically upon turning the inductor through 180° is nearly balanced by sending an accurately known current through the second coil. Two such observations allow the calculation of the vertical intensity to be made. Details are given of the measurement of the known current by a potentiometer and corrections for temperature. F. S.

1541. *Theory of Earth Currents Measurement.* **A. Petrowsky.** (Phil. Mag. 3. pp. 50–62, Jan., 1927.)—A pair of non-polarising electrodes is introduced into the earth and connected to each other through a sensitive galvanometer by means of a conductor. Differential equations and boundary conditions of work of the electrode are established for a limitless medium and an entire expression obtained for the potential. The modifications introduced for the case of an electrode (1) sunk a finite distance below the earth's surface, and (2) semi-sunk below the surface, the medium being thus limited in a vertical direction, are next introduced. Finally a series of figures is used to illustrate the distribution of isopotential surface and lines of force near the electrode under various conditions of short and open circuit. R. S. R.

1542. *Recurrence of Magnetic Storms and the Constitution of the Sun.* **H. Deslandres.** (Comptes Rendus, 183. pp. 1313–1317, Dec. 27, 1926.)—The author suggests [Abstracts 2710 (1926) and 491 (1927)] that the maxima of terrestrial magnetic storms are separated by time intervals of R/6, R/12, R/24, where R is the synodic rotation period of sunspots. The storms are caused by the ejection of particles from volcanoes on the sun which differ in longitudes by 60°, 30°, 15°. He confirms these conclusions by further examining Greenwich records since 1920. Not confining himself to the storm maxima, he finds deviations from the longitudes stated; these deviations do not exceed 8°, and the figures 8·1°, 4·5°, 3·2° occur repeatedly. It would then appear that there is, under the sun's surface, a layer which behaves like a solid of rotation period R. Twenty-four volcanoes underneath this layer, or fissures in it, are distributed regularly; from these electric particles are emitted, some at least at constant speed as in radioactivity. The regular distribution is common to uniformly cooling bodies; irregular cooling would lead to variable periods. H. B.

1543. *Magnetic Meridian Observations.* **T. G. Bocking.** (Colliery Guardian, 132. pp. 1342–1344, Dec. 17; and Disc., 1399, Dec. 24, 1926. Paper read before the Inst. Mining Engin. Birmingham, Dec., 1926.)—The results obtained from a series of magnetic observations in Staffordshire are discussed. For mine-surveying by magnetic methods it was important to know (1) whether changes in magnetic declination were the same underground as at the surface, and (2) whether changes in magnetic declination at Kew Observatory could be applied to underground workings of distant collieries. It was shown that on magnetically "quiet" days (1) and (2) could be accepted for collieries in England and Wales and probably also in Scotland, but not on "disturbed days." The author recommends the period 12–14 h. G.M.T. as the best for extended observations, and he also discusses the best procedure for mine-surveying. In the *Discussion* **S. L. Thacker** raised the questions of the action of magnetic strata and colliery power plants on the magnetic bearings obtained. [See also Abstract 488 (1927).] R. S. R.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1544. *Research in Radiology.* **N. S. Finzl.** (Brit. J. of Radiology, 23. pp. 4–14; Disc., 14–18, Jan., 1927.)—A presidential address dealing with the modern position and future advances in radiology. The subject is considered in relation to physics and chemistry, biology, industry, radiography and radiotherapy. In the discussion the question of protection was considered. B. J. L.

1545. *Radiometric Measurements on the Carbon Arc and Other Light Sources used in Phototherapy.* **W. W. Coblentz, M. J. Dorcas** and **C. W. Hughes.** (Bureau of Standards Sci. Papers, No. 539. pp. 535–562, 1926.)—The paper includes data of the spectral energy distribution of the carbon arc, the sun, a 1500-watt gas-filled tungsten lamp, the quartz mercury lamp and the nickel electrode and tungsten electrode arcs, as well as a study of cored carbons. The cyanogen band at 389 $m\mu$ is found to be decreased by the presence of strontium and nickel. The general ultra-violet radiation is greatly increased by nickel, cobalt and aluminium and is decreased by copper and tungsten. The effect of varying the current is investigated, and for some spectral ranges the ultra-violet component is greater with direct than with alternating current. With the correct size of carbon electrode the ultra-violet output may be increased twenty to fifty fold, so that with the proper size of cored carbon electrodes and working distances the same ultra-violet output can be obtained from an arc of 20 amperes as from one taking 90 to 125 amperes. The question of penetration is also discussed, and for wave-lengths above 1400 $m\mu$ the radiation cannot deeply penetrate the body tissues, according to the results of transmission experiments. Numerous curves and several tables are given to illustrate the experimental results. A not unimportant feature of the paper is the inclusion of the names of manufacturers whose special arc lamps and carbons were submitted to comparative tests. B. J. L.

1546. *An X-Ray Study of the Crystal Structure of Some Biological Objects.* **W. V. Mayneord.** (Brit. J. of Radiology, 23. pp. 19–30; Disc., 30–31, Jan., 1927.)—The results of X-ray examination of pearl nacre, hen's-egg shell, spicules of sponges and coral are given, and it is shown that the first has the structure of aragonite and the other substances have that of calcite. The Bragg structure of aragonite is confirmed. AUTHOR.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1547. *Heat of Layer Formation at the Limiting Surfaces of Solutions.* **P. Rehbinder.** (Phys. Zeits. 27. pp. 825–829, Dec. 15, 1926.)—When both the surface layer and the solution are dilute, the author's formula for obtaining the heat of adsorption from known thermodynamic equations is immediately applicable [Abstract 2206 (1926)]. With the help of the surface tensions, previously measured, the heats of adsorption of solutions of various surface-active substances are calculated. The formula $Q = \frac{1}{\Gamma}\left(\Delta\sigma - T\frac{\partial\Delta\sigma}{\partial T}\right)$, where Γ is the quantity of the capillary substance adsorbed at unit limiting surface, appears as a special case of the author's general formula, if $-\frac{\partial\sigma}{\partial c} = G = \frac{\sigma_0 - \sigma}{c}$, that is, if only the rectilinear initial portion of the σ/c curve is considered. Various conclusions concerning the relations between Q, Γ and c and the form of the dependency of the heat of adsorption on the temperature and concentration are drawn. T. H. P.

1548. *Mechanism of Adsorption of Water by Rubber.* **H. H. Lowry and G. T. Kohman.** (J. Phys. Chem. 31. pp. 23–57, Jan., 1927.)—Rubber swells while absorbing water to an extent very nearly equal to the volume of water absorbed. The most important factor determining the absorption of water by a given sample of rubber is the vapour pressure of the water with which it is in equilibrium. The absorption from a solution is found to be the same as that from an atmosphere having a pressure of water vapour equal to the vapour pressure of the solution. The absorption appears to consist of two processes: the formation of a true solution of water in rubber and the formation of solutions internal to the rubber of water-soluble constituents of the rubber, which can be removed by washing. The rate of water absorption is found to increase with temperature, but generally the amount absorbed is not greatly dependent upon temperature. Hydrostatic pressure of 10,000 lbs. per sq. in. has been found to reduce the rate of water absorption but to have very little effect upon the amount absorbed at equilibrium. The amount of water absorbed by rubber compounds is increased by a slow ageing process which takes place to the greatest extent on the surface. Rubber compounds of approximately 7 % combined sulphur undergo this ageing to the greatest extent. Increasing the rigidity of a rubber compound decreases greatly the amount of water absorbed. J. N. P.

1549. *The Sorption of Gas by Charcoal as a Dissolution Phenomenon.* **J. Sameshima.** (Chem. Soc. Japan, Bull. 2. 1. pp. 1–10, Jan., 1927.)—The velocity of absorption of carbon dioxide is smaller with granular than with powdered charcoal, while the total amount of gas absorbed is the same in each case. The total amount of carbon dioxide absorbed by various kinds of charcoal in various states of division is approximately the same in each case, being highest with pure sugar charcoal and lowest with impure forms such as soya bean charcoal. The results support the view that the sorption of gas by charcoal is a dissolution phenomenon, as opposed to the generally accepted surface adsorption theory. B. W. C.

1550. *Adsorption of Gases by Metallised Silica Gels.* **L. H. Reyerson** and **L. E. Swearingen.** (J. Phys. Chem. 31. pp. 88–101, Jan., 1927.)—Silica gels were metallised with silver, copper, platinum and palladium and the adsorption of oxygen, carbon monoxide, carbon dioxide, methane and ethylene was measured. The adsorption of hydrogen and sulphur dioxide by silica gels metallised with platinum, palladium and copper was also determined. Hydrogen was found to be more appreciably adsorbed by copper, platinum and palladium-treated gels. Carbon monoxide is specifically adsorbed by all metallised gels except copper. Oxygen is adsorbed by copperised gel, and the other metallised gels also exhibit adsorbtive powers for oxygen. There is no marked specific adsorption of the gels for methane. Metallised silica gels all adsorb ethylene more strongly than silica gel. No adsorption of carbon dioxide was found except in the case of copper. F. J. B.

1551. *The Adsorption of Benzene Vapour on the Plane Surfaces of Glass, Fused Quartz and Platinum. The Isosteric Heat of Adsorption of Benzene on Platinum.* **S. Lenher.** (Chem. Soc., J. pp. 272–281, Jan., 1927.)—The adsorption of benzene vapour at pressures above 90 % of the saturated equilibrium pressure is measured on the surfaces of glass, fused quartz and platinum. An unusually great adsorption on the platinum surface is observed. The free energy changes accompanying the adsorption are calculated from the equation $-\Delta F = RT\,ln\,p/p_1$. The isosteric heat of adsorption at constant pressure of benzene vapour on platinum is calculated from the adsorption isotherms in accordance with the relation $L = RT^2 d \log p_s/dT$. Within the accuracy of calculation the heat of adsorption is found to be of the same magnitude as the latent heat of condensation to liquid. The adsorption of vapours on solid surfaces over a wide range of pressure is discussed and a table is given showing the thickness of films exerting the saturated equilibrium pressure. [See also Abstract 2965 (1926).] J. N. P.

1552. *Theory of Mixtures.* **K. Lichtenecker.** (Phys. Zeits. 27. pp. 833–837, Dec. 15, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—The logarithmic rule giving the relation between the properties of a mixture and the properties of its constituents is shown to fit in accurately with Brooks' results for the electric conductivities of artificial gold-silver aggregates. In the case of the heat conductivity of alloys few data are available, but those quoted support the rule. In the case of the dielectric constants of certain organic mixtures the rule is also shown to be much more successful than any other proposed. It has been used with success to determine beforehand the refractive indices of glasses of different composition. It is also in complete accord with the measurements of Schütt on solutions up to 25 % by weight of common salt in water. In all cases account must be taken of volume changes on mixing. G. A. S.

1553. *Solubility of Pure and Atmospheric Nitrogen in Distilled and Sea Water.* **J. H. Coste.** (J. Phys. Chem. 31. pp. 81–87, Jan., 1927.)—The effect of argon on the solubility of pure and atmospheric nitrogen in distilled water was measured. The available data have been collated and discussed. The results show that with proper allowance for the effect of argon on the solubility of atmospheric nitrogen, considerable uncertainty exists as to the absorption coefficients of both this mixed gas and pure nitrogen in distilled water, and a similar uncertainty exists in the case of sea-water. Congelation appears to be the best means of freeing water from dissolved gases. F. J. B.

1554. *The Gas Coagulation Theory as Applied to the Drying of Fatty Oils.* **L. Auer.** (Kolloid Zeits. 40. pp. 334–338, Dec., 1926.)—In order to determine the validity of different chemical and physical theories which have been put forward to account for the drying of oil films, measurements are made of the increase of weight with time of films of linseed oil, wood oil and linseed oil varnish when exposed on thin plates to air or to carbon dioxide under ordinary conditions, when free from water vapour, and when at a pressure of 10 mm. In all cases a progressive increase in weight with time accompanied by film formation is observed, which, in experiments at low pressures, is greater than can be attributed to absorption of the enclosed air or gas. It is concluded that even at the low pressures the gas has a coagulating action on the thin oil layer and that this gel has then the property of rapidly adsorbing air to an equilibrium concentration depending on its degree of gelation. The fatty oils are classified as lyophilic sols, owing their stability to their high degree of solvation. Desolvation proceeds in steps through the influence of gas and is followed by gelation and coagulation. In experiments conducted in a high vacuum of 10^{-6} mm. pressure in sealed glass tubes no drying of the films or subsequent increase of weight is obtained. Differences in the physical nature of the films are obtained when the drying is conducted in different gases. The drying of films in gases at low pressures is shown to be accompanied by the evolution of a small amount of gas not yet identified. Reference is made to some observations according to which during drying emission occurs of a radiation similar to, but not identical with, γ-rays. J. N. P.

1555. *Charges on Colloidal Particles.* **R. Wintgen.** (Kolloid Zeits. 40. pp. 300–302, Dec., 1926.)—The electrically charged particles in a colloid solution behave in many respects like ions. The determination of the charge carried by such particles is important. The normality of the sol can be estimated by conductivity measurements as a difference between the conductivity of the sol and the ultra-filtrate. The colloidal particles can be counted by the ultramicroscope, and the charge is given by the equation $e = n\mathrm{N}/t$, where N is the Avogadro number and t the number of colloid particles per litre. The method was applied to sols of ferric oxide and gold. The effect of ultrafiltration on the specific conductivity of water was measured, and the increase in conductivity proved the reliability of the experimental method. F. J. B.

1556. *Electrical Resistance of Concentrated Sulphuric Acid and the Theory of Hydration of Colloids.* **M. H. Fischer and M. O. Hooker.** (Kolloid Zeits. 40. pp. 303–307, Dec., 1926.)—The resistance of ordinary concentrated sulphuric acid and of "fuming" sulphuric acid, each diluted with small quantities of water, was determined. The results, when plotted, show a regular increase in resistance as the amount of water increases. A change in the curve was observed when the resistance was measured at three different temperatures, 19°, 30° and 39° C. This is taken to indicate the solution of water in sulphuric acid. Analogy is drawn between the behaviour of concentrated sulphuric acid and colloids which swell as they absorb water. F. J. B.

1557. *Use of Donnan's Membrane Equilibrium Theory for the Determination of the Charge of Colloid Particles.* **N. Bjerrum.** (Phil. Mag. 3. pp. 22–26, Jan., 1927.)—The author replies seriatim to the objections raised by Rinde [Abstract 1138 (1926)] to his paper on the theory of osmotic pressures, etc. [Abstract 2853 (1924)]. T. H. P.

1558. *The Parachor and Chemical Constitution. Part IV. Three-Membered and Four-Membered Rings.* **S. Sugden** and **H. Wilkins.** (Chem. Soc., J. pp. 139–147, Jan., 1927.)—Measurements are made of the surface tension and density of eleven compounds of different structures. The parachor [P] is calculated from the relation $[P] = \gamma^{1/4}M/(D - d)$, where γ is the surface tension, M the molecular weight, D the density of the liquid, and d that of the vapour. The "structural" parachor for a three-membered ring is found to be 17; individual substances show variations of a few units from this value. The value for a four-membered ring is shown to be 11·6. Structural parachors are proportional to the degree of unsaturation of the multiple bond or ring structure concerned, the degree of unsaturation being given by the value x/n, where x is the number of latent valencies and n the number of octets. [See also Abstracts 2390 (1924) and 41 (1926).] J. N. P.

1559. *Experimental Contributions to the Theory of Diffusion.* **E. Wilke** and **W. Strathmeyer.** (Zeits. f. Physik, 40. 3–4. pp. 309–321, 1926.)—In order to obtain accurate results, it must be possible to determine the concentration at any moment and at any point in the area of diffusion with the utmost precision. For this purpose small floats of definite specific weights proved excellent. They consisted of fine glass capillaries not more than 1 mm. in diameter and about 2 cm. long which would float horizontally in a homogeneous liquid. The concentration may by this method be determined with extraordinary accuracy. To attain equal accuracy with regard to position the path of diffusion should be fairly long. It is quite possible to determine the position of a float to 0·1 mm. Thus with a path of 1 decimetre an accuracy of 0·1 % is achieved. An experiment lasted six weeks, so that the element of time presented no difficulty. Special precautions were taken to avoid mechanical vibration, although, contrary to the assumption of previous investigators, it was not found to affect the speed of diffusion. Fluctuations of temperature, on the other hand, have a greater influence than hitherto supposed, and were therefore carefully eliminated. Measurements of halogen hydracids in strong concentrations show that their coefficient of diffusion periodically rises with the concentration and again falls. The paper contains several tables and curves and is partly mathematical. E. F.

1560. *Diffusion in a Gravitational Field.* **R. Fürth.** (Zeits. f. Physik, 40. 5. pp. 351–363, 1926.)—By means of the diffusion theory a derivation is made of the mathematical relations which determine the sedimentation of a colloidal or crystalloidal solution. The change is considered which is produced by the operation of gravity and of diffusion in a system initially of uniform distribution, and a calculation is made of the distribution of density as a function of the height and of the time. The formulæ derived enable a determination to be made of the time required to reach the equilibrium condition during sedimentation. This sedimentation time is approximately proportional to the square of the height of the liquid column. Discrepancies which have been observed in former experiments in density distribution measurements in large and small vessels are attributed to equilibrium not being attained. J. N. P.

1561. *Condition of Silver Chromate in Gelatine from Electric Conductivity and Diffusion Experiments.* **A. C. Chatterji** and **N. R. Dhar.** (Faraday Soc., Trans. 23. pp. 23–30, Jan., 1927.)—The amount of silver chromate that can remain in suspension in a 5·67 % gelatine gel is found to be much greater than the value of the solubility product in water, indicating that large quantities of silver chromate can exist in the peptised condition in gelatine. This conclusion is further supported by the results of measurements of electric conductivity and of diffusion. The chemical change between silver nitrate and an equivalent quantity of potassium chromate is not complete in presence of gelatine; an amount of potassium chromate remains free. This is explained by the more marked adsorption of silver ions than that of chromate ions by gelatine. The formation of Liesegang rings is attributed to the coagulation of peptised silver chromate, which occurs only when its concentration is within a definite limit. J. N. P.

1562. *Lyotropic Properties of the Fluorine Ion.* **H. Freundlich** and **M. Aschenbrenner.** (Kolloid Zeits. 41. pp. 35–40, Jan., 1927.)—Measurements are made of the influence of the F′ and SCN′ anions compared with those of Cl′ and Br′ on the solubility of the slightly soluble compound phenylthiourea, the raising of the surface tension of water-air, the p.d. of the water-air interface, the solidification point of gelatine solutions, and on the coagulation values of sols of ferric and cupric oxide. Determinations are also made of the heats of hydration of the anions and their influence in catalytic reactions such as the inversion of sugar, whereby a lowering of the effective hydrogen-ion concentration is produced. It is found that in all these cases the F′ ion occupies a position at one end of the so-called lyotropic or Hofmeister series corresponding to its high degree of hydration, while the SCN′ ion is situated at the opposite end of the series. In measurements of the degree of adsorption by charcoal the expected relation is not obtained in that the F′ ion is more strongly adsorbed than the Cl′ ion. J. N. P.

1563. *The Mobility of Ions in Solution, with Particular Reference to the Separation of Isotopes.* **E. R. Jette.** (Phil. Mag. 3. pp. 258–269, Jan., 1927.)—Experimental evidence from ionic mobility, molecular conductance, and diffusion does not give unequivocal support either to the hydrodynamic or to the kinetic theories for the movement of ions in a solvent. The simplified form of Rindemann's equation $V = \frac{Ft}{m}$ does not truly represent the velocity due to an electrical field for univalent ions, while Walden's equations are purely empirical and no theoretical basis can be found for them, the experimental agreement being apparently fortuitous. Kinetic considerations do not take into account electrostatic effects between the ions and the solvent or cohesive forces between the solvent molecules; the present tendency is to extend the Stokes-Kirchhoff equation or hydrodynamic theory to apply to smaller particles. It is quite certain, however, that no separation of isotopes due to difference in the mobilities of isotopic ions is to be expected. B. W. C.

1564. *Relation between Pseudo-Binary Lines and Solid Solutions in Metallic Ternary Systems.* **R. A. Morgen.** (Am. Chem. Soc., J. 49. pp. 39–43, Jan., 1927.)—Measurements are made of the Cu_2 Sb-Pb line in the lead-antimony-copper system. A pseudo-binary line is defined as the line connecting the point, representing a compound between two constituents, with the third constituent in a ternary system. Experimental evidence is given to show that mixtures corresponding to compositions on this line do not behave like an ordinary binary system. Photomicrographic as well as analytical evidence is used to show that solid-solution formation may proceed at the expense of a weak metallic compound. J. N. P.

1565. *Recrystallisation of Copper Wire.* **E. Schmid** and **G. Wassermann.** (Zeits. f. Physik, 40. 6. pp. 451–455, 1926.)—After heating to 1000° C. hard-drawn copper wire is shown to recrystallise with a simple fibre structure with its 112 direction parallel to the wire axis. Wire showing this structure is distinguished by absence of elastic fatigue. J. E.

1566. *A Method of Preparing Molecular Mixtures.* **S. v. Bogdandy, J. Böhm** and **M. Polányi.** (Zeits. f. Physik, 40. 3–4. pp. 211–213, 1926.)—Semenoff and Schalnikoff reported the preparation [see Abstract 506 (1927)] of explosive reactions in very finely divided mixtures of cadmium and sulphur. This work suggested the authors' experiments, of which the paper is a brief report. They used a rapidly rotating drum cooled from the inside, and projected on to this drum the vapour of the substances to be mixed. The drum was placed in a vacuum. The materials A and B were deposited in alternate layers. The weigh tof metal deposited varied from 1 to 30 % by weight. One of the two substances was naphthalene. The substance so prepared was examined with Röntgen rays and gave no interference. The metallic deposit when separated from the naphthalene by dissolving the latter and heating to redness showed a metallic lustre and gave a Röntgen powder diagram. T. B.

1567. *Decomposition of Ammonia by Optically Excited Mercury Atoms.* **R. G. Dickinson** and **A. C. G. Mitchell.** (Nat. Acad. Sci., Proc. 12. pp. 692–696, Dec., 1926.)—The photochemical decomposition of ammonia into nitrogen and hydrogen at low pressure is sensitised by mercury vapour when the radiation used is furnished by a cooled quartz mercury-arc lamp and is filtered so as to remove light of wave-lengths below 2340 Å. The decomposition thus sensitised is accompanied by diffuse-band fluorescence in the green and ultra-violet. T. H. P.

1568. *Formation of Ammonia from the Elements by Silent Discharges in Siemens Tubes.* **E. Warburg** and **W. Rump.** (Zeits. f. Physik, 40. 8.

pp. 557–573, 1926.)—The formation of ammonia from the elements shows characteristic differences from the formation of ozone and other reactions in the Siemens tube. Thus, (1) the ammonia is formed mainly at the surface, ozone in the interior, of the discharge space; (2) the yields per coulomb are of similar orders of magnitude for other reactions, but for ammonia formation exceptionally small; (3) diminution of the pressure depresses the yield of ammonia far less than that of ozone. Results (2) and (3) appear to be consequences of (1) in that the number of ionic impacts on the surface is very small in comparison with that in the interior and, with similar ionic condition, does not depend on the pressure. Result (1) is probably a consequence both of the high heat of dissociation of the nitrogen and of the catalytic action of the glass surface. In contrast to ozone formation, the formation of ammonia at the ordinary temperature is a process which can take place of itself and is hence catalysed by the impacts of the ions on the surface. This catalytic surface action shows a variable behaviour similar to that found with chemical reactions occurring without an electric current, and on this account probably depends on small quantities of substances present in variable amounts. The formation of hydrogen iodide from the elements in the Siemens tube is also a catalytic process, but in other respects resembles, not the formation of ammonia, but that of ozone, and is therefore catalysed by internal ionic impacts. T. H. P.

1569. *Rate of Monomolecular Reactions.* **J. J. Thomson.** (Phil. Mag. 3. pp. 241–257, Jan., 1927.)—The expression derived by Hirst and Rideal [see Abstract 638 (1926)] to account for the variations with pressure of the rate of the monomolecular reaction $2N_2O_5 = 2N_2O_4 + O_2$ is shown to be not completely satisfactory, although it takes into account the effect of radiation as well as collisions. It is shown that if the forces inside the molecule are intermittent and not continuous, the energy content of a molecule will wax and wane, even when there is no communication of energy by collision or radiation; the total energy will be distributed among the molecules according to Maxwell's law of distribution. The rate of the reaction will thus be measured by the number of molecules which in unit time will receive from the surrounding molecules sufficient energy to render them active. This surging of energy due to the intermittence of the forces in the molecule may be regarded as a series of impacts, and the time interval between them may well be small compared with that of collisions between molecules or between molecules and light-quanta, *i.e.*, the rate of the reaction at low pressures would be much more rapid than that due to collisions or to radiations, thus accounting for the experimental facts of Hirst and Rideal. B. W. C.

1570. *Surface Adsorption and Velocity of Chemical Action at Gas-Solid Interfaces.* **F. H. Constable.** (Cambridge Phil. Soc., Proc. 33. pp. 593–606, Jan., 1927.)—The fact that decrease in the pressure of the reactant has little effect on the velocity of unimolecular reactions on saturated catalysing surfaces, whilst inert diluents cause a marked decrease in the velocity, had been explained by the author [see Abstract 1943 (1926)] on the basis of the absorption theory of Langmuir and Frenkel and of modern views concerning the centres of activity on catalysing surfaces. The formulæ deduced are confirmed by experiments on the initial stages of the dehydrogenation of alcohol by copper and on the effects of the addition of vapours of water, benzene and acetone on this reaction. The liquid reactant and the diluent are contained in two glass boilers, electrically heated directly by bare coils. The nichrome coils used by W. G. Palmer in similar experiments were replaced by platinum coils, because hydrogen was evolved at the former. In experiments made with thoria as catalyst the effect of the hydrogenation, which followed the rule stated, was difficult to separate from the dehydration, a highly-reactive complex with water being formed. The reaction must take place while the reactant is in the adsorbed state, as a gas, liquid or solid; only in the first two cases the adsorbed molecule would be free to wander before it evaporates again. As adsorption is general for many substances, however, whilst catalysis is rare, the author concludes that mutual bombardment of the molecules in the surface film cannot be the cause of the catalysis. Molecules have to be preliminarily activated before they can react, and since the ranges of molecular forces are short, reaction should occur in the molecules actually residing on the centres of activity of the surface, which momentarily form part of the lattice structure. Activation takes place in those molecules which remain adsorbed for most of their mean life on the centres of activity. H. B.

1571. *Rate of Maximum Activation by Collision for Complex Molecules.* **R. H. Fowler** and **E. K. Rideal.** (Roy. Soc., Proc. 113. pp. 570–584, Jan. 1, 1927.)—A careful analysis of the mechanism of activation of complex gaseous molecules by collision shows that for the activation of N_2O_5 and the dissociation of Br_2 the maximum possible rate attainable has not yet been proved inadequate to supply the necessary number of active molecules or dissociated atoms to account for the observed rates of reaction. B. W. C.

1572. *Activation of Molecular Hydrogen by Electron Impact.* **G. Glockler, W. P. Baxter** and **R. H. Dalton.** (Am. Chem. Soc., J. 49. pp. 58–65, Jan., 1927.)—A vacuum tube is described in which hydrogen molecules can be activated by electrons of known velocity and then allowed to react with copper oxide. The water formed is frozen out and pressure changes followed with a Pirani gauge. The reaction is found to begin at 11·4 volts, while a resonance point is also found at the same voltage by a Franck current-potential curve. This agrees with the first resonance potential found by spectroscopy at 11·6 volts. It is concluded that a resonated hydrogen molecule is the first step in the activation process. No evidence is found that 3- to 5-volt electrons dissociate hydrogen molecules. F. S.

1573. *Combustion of Carbon Monoxide.* **C. F. R. Harrison** and **J. P. Baxter.** (Phil. Mag. 3. pp. 31–50, Jan., 1927.)—A new method of investigating flame velocities at constant volume in a sphere by means of resistance thermometers and an Einthoven galvanometer is described. The results obtained for the explosion $2CO + O_2 = 2CO_2$ with varying diluents and impurities at the initial pressure 105 cm. show that the combustion of carbon monoxide takes place both by direct oxidation to CO_2 and by oxidation with the intervention of water. In the second case, ignition is the easier and the flame-speed much the higher, but under ordinary conditions the two reactions occur simultaneously. Replacement of the nitrogen diluent by oxygen or carbon monoxide produces a considerable acceleration in the velocity of both combustion and flame-spread. The effect of carbon monoxide as a diluent is much greater than that of oxygen in accelerating the combustion, but it is not clear if this is due entirely to the dissociation effect or to the possible activation of nitrogen. The presence of extremely small traces of hydrogen in the mixture produces effects out of all proportion with the amount of hydrogen present, as little as 0·5 % of hydrogen completely altering the process of combustion of the carbon monoxide-air mixture. The method used not only serves for the accurate measurement of the spread of flame from point to point in a spherical or other closed vessel, but may be used to obtain an indication of the manner in which the temperature rises at any point of the explosion chamber. T. H. P.

1574. *Methane Equilibrium.* **R. C. Cantelo.** (J. Phys. Chem. 31. pp. 124–130, Jan., 1927.)—Calculations of equilibrium constants for the possible reactions involved in the decompositions of methane, ethylene and ethane give results indicating that at temperatures above 400° the final system should be one of methane, carbon and hydrogen, irrespective of which hydrocarbon is used as the initial system. The results are also in agreement with the experimental data of previous investigators.

T. H. P.

1575. *Note on the Electric Potentials of Ions in Salt Solutions.* **J. A. V. Butler.** (Phil. Mag. 3. pp. 213–215, Jan., 1927.)—If a charge is introduced into a salt solution (of fixed ionic strength K) and increased by infinitesimal amounts, the potential ψ_i at its surface due to the ion atmosphere resulting is e_iK/D when a total charge e_i has accumulated. The work done in introducing a charge $z_i e_i$ (where z_i is the number of unit charges ϵ on ions of the ith kind) is

$$\mathrm{A}_i = \int_0^{z_i\epsilon} e_i \mathrm{K}\,de/\mathrm{D} = -\,z_i^2\epsilon^2\mathrm{K}/2\mathrm{D},$$

and it is the purpose of the present paper to show that this quantity does, in fact, function as the free energy. The author introduces a novel conception in the treatment of heterogeneous equilibrium, the potential of a phase being defined with respect to a standard phase in terms of the potential differences at the boundaries separating them. H. H. Ho.

1576. *Interpretation of the Time-Law for the Formation of Hydrogen Bromide from its Elements.* **A. Skrabal.** (Ann. d. Physik, 82. 1. pp. 138–142, Dec. 16, 1926.)—Bodenstein and Lind's formula for the combination of hydrogen and bromine in the dark was first derived by them experimentally and later given a theoretical interpretation, based on the classical chemical kinetics, by Herzfeld. The present author has found Herzfeld's work to be not quite rigid, and, since the formula has been generally accepted and utilised, he now attempts to derive the formula on theoretical grounds which are free from objection. The paper is entirely mathematical. H. H. Ho.

1577. *Mass Unit of the Chemical Potential.* **W. D. Bancroft.** (J. Phys. Chem. 31. pp. 69–80, Jan., 1927.)—Discussion of various passages from the collected papers of W. Gibbs leads to the following general conclusions. As regards chemical potential, all that is measured is the difference of potential due to some chemical reaction, not absolute chemical potential. The latter may be referred to any units of mass, but general relations are brought out more clearly if these units are appropriate to the reaction used. For reactions involving the pressures of gases or the osmotic pressures of solutions, the appropriate mass units are the molecular weights of the reacting substances or ions. For electrochemical reactions, however, the appropriate mass units are the electrochemical equivalents, the masses transferred with one coulomb; these equal the equivalent weights divided by the Faraday constant. The appropriate units of mass for electrical endosmose or frictional electricity are as yet undetermined. For organic compounds as many chemical potentials are possible as there are bonds which can be broken or activated. The mass law equations have been deduced from the reaction velocity equations and from the relations between the chemical potentials, but the reaction velocity equations do not appear to have been deduced from the relations between the potentials, although the difference of chemical potential must be one of the factors determining the reaction velocity and although Ohm's law holds absolutely for reactions occurring under certain well-defined conditions. T. H. P.

1578. *Electrode Equilibrium in the Weston Standard Cell.* **W. C. Vosburgh.** (Am. Chem. Soc., J. 49. pp. 78–92, Jan., 1927.)—Among the properties investigated are abnormally high initial e.m.f.'s., indefinite decrease in e.m.f. and hysteresis. Excess of mercuric ion is found to be harmful, while acid cells are found to be more reliable than neutral ones. An acid concentration of about 0·01 mol. per litre has been found satisfactory. F. S.

1579. *The Volta Effect and the Action of the Cell. Electronic Theory of the Cell. Notes* 1 *and* 2. **O. M. Corbino.** (Accad. Lincei, Atti, 5. pp. 68–74, and 74–79, Jan. 16, 1927.)—The theory of the voltaic cell is discussed on the basis of the behaviour and movements of the electrons. Analogies between the action of the cell with ionised gas, the mechanical cell, and the cell with electrolyte are considered. The existence of the Volta effect even *in vacuo*, and therefore independently of all chemical action, having been established, the bimetallic couple, such as copper-zinc, constitutes a natural means of producing an electrostatic field in a space even of large dimensions, as a permanent magnet (yet with less stability) creates around itself a magnetic field. The origin of the energy of the electrostatic field is purely physical; it is derived from the different energy of attachment of the electrons of conduction to the different metals. J. J. S.

1580. *The Lead Accumulator. Note* 2. **L. Mazza.** (Accad. Lincei, Atti, 5. pp. 117–119, Jan. 16, 1927.)—An investigation of the products that are formed during the action of the lead accumulator. J. J. S.

1581. *Potential Differences by Adsorption and Diffusion in an Electrical Field.* **O. Blüh.** (Phys. Zeits. 28. pp. 16–22, Jan. 1, 1927.)—Potential measurements were made on a number of salts and dyes by means of the filter-paper electrodes developed in a previous investigation. The adsorption of the various ions at the anode and kathode was determined. The behaviour of basic and acid dyestuffs were very different.

Safranine and methyl violet coloured the kathode—*i.e.*, at the pole to which they migrated—and showed a strong potential difference increase, while acid dyestuffs, such as Tropaolin, Congo Rubin, Trypan Red and others bring about a scarcely visible change at the electrodes. F. J. B.

1582. *Thermodynamical Theory of Reversible Electrodes.* **B. Szyszkowski.** (Acad. Polonaise, Sci. et Lettres, Bull. 8a. pp. 313–323, Oct., 1926.)—This is a theoretical paper dealing with the application of the laws of thermodynamics to the problem of the equilibrium between an electrode and a solution of electrolytes. T. H. P.

1583. *Potential Difference Across a Semi-Permeable Membrane.* **N. Kameyama.** (Phil. Mag. 3. pp. 235–240, Jan., 1927.)—It has been tested experimentally whether the potential difference across a copper ferrocyanide membrane in the system $K_4(FeCy)_6(m_1)||K_4(FeCy)_6(m_2)$ is given by $E_m = \frac{RT}{F} Ln \frac{[K]_1}{[K]_2}$, where [K] represents the activity of the potassium ion. For this purpose the chain was set up :—

$$\text{K-amalgam}|K_4FeCy_6(m_1)||K_4FeCy_6(m_2)|\text{K-amalgam}.$$

Here E_m is just balanced by the concentration cell with respect to K^+-ion at the ends of the chain. The nullity of the total e.m.f. is taken as a verification of the above relation. The results confirm this theory so long as the solutions are not dilute enough to cause disturbance due to interaction of the amalgam with the water. A. C. M.

1584. *Use of the Quinhydrone Electrode in Electrometric Titrations.* **A. J. Rabinowitsch** and **V. A. Kargin.** (Zeits. Elektrochem. 33. pp. 11–14, Jan., 1927.)—By means of the quinhydrone electrode strong acids, in reasonable amounts, may be titrated with great accuracy. With weak acids, however, there results an error which diminishes as the strength of the acid increases; this error is almost constant for any given acid, and hence virtually vanishes if large quantities are titrated. This electrode gives inaccurate values for p_H, not only in alkaline solutions, but also in neutral and faintly acid solutions of weak acids which are not sufficiently buffered. T. H. P.

1585. *Deformation of Curves of Combination of Acids and Alkalies with Albumen in the Presence of Strong Electrolytes.* **L. Reiner.** (Kolloid Zeits. 40. pp. 327–332, Dec., 1926.)—When albumen is added to a measured quantity of acid or alkali, and the excess of free acid or alkali determined electrometrically, the degree of combination of acid and alkali with albumen is found. The migration numbers and the combination of acids and alkalies with various albumens were determined, and the bearing of the results on the dissociation and ionic activity of albumen is discussed. F. J. B.

1586. *An Electrometric Study of Tungstic Acid.* **H. T. S. Britton.** (Chem. Soc., J. pp. 147–150, Jan., 1927.)—E.m.f. measurements are made by a hydrogen electrode during the back-titration by hydrochloric acid of a solution of tungstic acid in sodium hydroxide. The curve of pH values plotted against concentration of acid shows a sharp diminution in pH when the amount of acid added to react with the alkali exceeds that required to form the normal sodium tungstate. No noticeable inflexion is obtained at a composition corresponding to $NaHWO_4$, but a large inflexion is produced when the acid is about one-quarter neutralised, a point which corresponds to the formation of the supposed paratungstates $3Na_2O, 7WO_3, 21H_2O$ or $5Na_2O, 12WO_3, 28H_2O$. An indication is also obtained that some form of union occurs at the point corresponding to the metatungstate $Na_2W_4O_{13}$. No precipitation of tungstic oxide occurred throughout the titration even in presence of a large excess of hydrochloric acid, the solution remaining clear, suggesting that the oxide had passed into a sub-colloidal state and not into combination with the acid. At a value of $H = 10^{-4}$ the hydrogen in the electrode begins to reduce catalytically the sexavalent tungsten to the quinquavalent state, as is indicated by the appearance of the characteristic blue coloration around the electrode. For higher acid values resort is made to the oxygen electrode. J. N. P.

1587. *The Normal Oxidation-Reduction Potential of Mercury.* **S. R. Carter and R. Robinson.** (Chem. Soc., J. pp. 267–272, Jan., 1927.)—The perchlorates of mercury are found to be practically free from the disadvantages in potential measurements of low solubility, small degree of ionisation, and a tendency towards the formation of complex salts and ions which are possessed by most mercury salts. Potential measurements are made with cells containing a platinum wire immersed in mixtures of mercuric and mercurous perchlorates which are connected through a potassium nitrate solution to a normal calomel electrode. By applying corrections for the estimated degree of dissociation of the salts, the normal potential E_0 is derived from the measured potential E by means of the relation $E = E_0 + 0{\cdot}029 \log [Hg^{\cdot\cdot}]^2 [Hg_2^{\cdot\cdot}]$. The normal oxidation potential of the process $2Hg^{\cdot\cdot} \rightarrow Hg_2^{\cdot\cdot}$ is thus estimated to be $+ 1{\cdot}190$ volts on the absolute scale or $+ 0{\cdot}913$ volt on the hydrogen scale. The effect of free perchloric acid is investigated. J. N. P.

1588. *A Dilution Law for Strong Electrolytes.* **B. Szyszkowski.** (Acad. Polonaise, Sci. et Lettres, Bull. 8a. pp. 324–346, Oct., 1926.)—According to Debye and Hückel, the diminution of equivalent conductivity of electrolytes with increasing concentration is due to a decrease in the mobility of the ions and not to a decrease in their number, *i.e.*, the electrolytes are completely dissociated at all concentrations. On this assumption an expression is developed

$$1 - \alpha = 1 - \frac{\lambda}{\lambda_0} = \frac{1}{2(\nu - 1)}[\beta c^{1/2} - 2\gamma c + 3\delta c^{3/2} \ldots]$$

in which $\alpha = \dfrac{\lambda}{\lambda_0}$ is the quotient of the equivalent conductivity by the conductivity at infinite dilution, ν is the number of ions into which the electrolyte dissociates, c is the concentration in mols. per litre, and β, γ, δ are constants. Taking Kohlrausch's conductivity measurements for a wide series of salts (sixteen in all), this expression is shown to be in very good agreement with the experimental facts over a wide range of concentrations. B. W. C.

1589. *Periodic Electrochemical Passivity of Iron, Cobalt, Nickel and Aluminium.* **E. S. Hedges.** (Chem. Soc., J. pp. 2878–2887, Nov., 1926.)—Periodicity is observed in the passivity of an iron anode in sulphuric, nitric and phosphoric acids, a cobalt anode in sulphuric acid, a nickel anode in sulphuric acid, and an aluminium anode in nitric acid and in caustic soda solution. In each case the effect is produced when the concentration, current density, temperature, etc., are arranged so that the electrode has approximately equal chances of being in the active or in the passive state. Under such conditions the electrode oscillates regularly between the two states. Periodic phemomena may also be produced by electrolysis in a solution containing a mixture of passivating ions and activating ions—for instance, by adding ammonium chloride to an ammonium sulphate solution in which a nickel anode has been made passive. The periodic passivity phenomenon does not seem to differ in any respect from the periodic film formation at other metallic anodes. Immediately before passivation of the anode a visible film forms over the metal, but this disappears at the commencement of oxygen evolution.

T. H. P.

1590. *Electrolytic Polarisation. Part IV. Electrodeposition Potentials of Iron, Cobalt and Nickel. Part V. Electrodeposition Potentials of Alloys of Iron, Cobalt and Nickel.* **S. Glasstone.** (Chem. Soc., J. pp. 2887–2902, Nov., 1926.)—Part IV.—The initial deposition potential of iron, cobalt and nickel, measured at various temperatures by the commutator-extrapolation method, is independent both of the hydrogen-ion concentration of the solution and of the nature of the anions present. Moreover, the results do not appear to be affected by the presence of depolarisers. The different theories which have been advanced to account for the retardation of the deposition of the iron-group metals are examined and are found at variance with the observed facts. It is suggested alternatively that the metals are deposited primarily in an unstable form with an electronic arrangement different from that of the ordinary form.

Part V.—The initial deposition potentials of alloys of iron, nickel and cobalt, in pairs or all together, from solutions of various metallic and hydrogen-ion concentrations, measured at 15°, 55° and 95° C., vary with the ratio of the metals in solution and with the temperature, but are independent of the hydrogen-ion concentration. In the light of a theory previously proposed to account for the overvoltage of deposition of the iron-group metals, these results indicate that, in the deposition of alloys of iron with nickel and with cobalt the concentration of iron in the alloy should increase rapidly with increasing current density to an almost constant value. T. H. P.

1591. *Activity Coefficients, Ionic Concentrations and Kinetic Salt Effects of Formic Acid in Neutral Salt Solutions.* **H. S. Harned.** (Am. Chem. Soc., J. 49. pp. 1–9, Jan., 1927.)—The activity coefficient products of formic acid in salt solutions of various kinds and strengths are calculated from the results of Manning, and on the assumption that the velocity of hydrolysis of ethyl formate in neutral salt solutions is proportional to H-ion concentration. The values obtained correspond satisfactorily with the behaviour of the ionic activity-coefficient product of water in salt solutions. A theory of the thermodynamic behaviour of hydroxyl and formate ions is advanced and discussed. A. B. C. L.